HP Z1 Workstation

Maintenance and Service Guide

Copyright Information

© Copyright 2012, 2013 Hewlett-Packard Development Company, L.P

Second Edition: February 2013

First Edition: April 2012

685888-002

Warranty

Hewlett-Packard Company shall not be liable for technical or editorial errors or omissions contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material. The information in this document is provided "as is" without warranty of any kind, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose, and is subject to change without notice. The warranties for HP products are set forth in the express limited warranty statements accompanying such products.

Nothing herein should be construed as constituting an additional warranty.

The information contained herein is subject to change without notice. The only warranties for HP products and services are set forth in the express warranty statements accompanying such products and services. Nothing herein should be construed as constituting an additional warranty. HP shall not be liable for technical or editorial errors or omissions contained herein.

Trademark Credits

Microsoft and Windows are U.S. registered trademarks of Microsoft Corporation.

Intel, Intel Xeon, and Intel Core are trademarks of Intel Corporation in the U.S. and other countries.

FireWire is a trademark of Apple Computer, Inc., registered in the U.S. and other countries.

Bluetooth is a trademark owned by its proprietor and used by Hewlett-Packard Company under license.

ENERGY STAR is a registered trademark owned by the U.S. Environmental Protection Agency (EPA).

About this guide

This guide provides service and maintenance information for the HP Z1 Workstation.

IMPORTANT: Removal and replacement procedures are now available in videos on the HP website.

Go to the HP Customer Self Repair Services Media Library at http://www.hp.com/go/sml.

This guide includes these topics:

Guide topics
Hardware overview on page 1
System management on page 11
Component replacement information and guidelines on page 40
Diagnostics and troubleshooting on page 54
Configuring password security and resetting CMOS on page 93
Configuring RAID devices on page 100
Linux technical notes on page 97
Configuring RAID devices on page 100
System board designators on page 105

NOTE: View the *HP Z1 Workstation User Guide* at http://www.hp.com/support/workstation_manuals.

Table of contents

1 Hardware overview 1

Front and bottom components 2
Side components 3
Rear components 4
Chassis components 5
System board components 6
System board architecture 7
Workstation specifications 8
Physical characteristics and technical specifications 8
Environmental specifications 10
Location and ventilation 10

2 System management 11

Power management features 11
ERP compliance mode 11
Hyper-Threading Technology (HTT) 12
SATA Power Management 12
Intel Turbo Boost Technology 12
HP Cool Tools 12
BIOS ROM 12
Computer Setup (F10) Utility 13
Computer Setup (F10) Utility functionality 13
Accessing Computer Setup (F10) Utility 14
Computer Setup (F10) Utility menu 15
Desktop management 23
Initial computer configuration and deployment 24
Installing a remote system 24
Copying a setup configuration to another computer 25
Updating and managing software 26
HP Client Management Solutions 26
Altiris Client Management Solutions 26
HP SoftPaq Download Manager 27
System Software Manager 27
ROM Flash 27
Remote ROM Flash 27
HPQFlash 27

FailSafe Boot Block 28
Recovering the computer from Boot Block Recovery mode 28
Workstation security 28
Asset tracking 29
SATA hard disk drive security 30
DriveLock applications 31
Using DriveLock 31
Password security 33
Establishing a setup password using Computer Setup (F10) Utility ... 33
Establishing a power-on password using computer setup 34
Entering a power-on password 34
Entering a setup password 35
Changing a power-on or setup password 35
Deleting a power-on or setup password 36
National keyboard delimiter characters 36
Clearing passwords 37
Chassis security 37
Smart Cover Sensor 37
Cable lock (optional) 37
Fault notification and recovery 38
Drive Protection System 38
ECC fault prediction 38
Thermal sensors 38
Dual-state power button 39
Changing the power button configuration (Windows only) 39

3 Component replacement information and guidelines 40

Warnings and cautions 41
Service considerations 42
Tools and software requirements 42
Electrostatic discharge (ESD) information 42
Product recycling 43
Component replacement guidelines 45
Battery 45
Cable management 46
CPU (processor) and CPU heatsink 47
Expansion slots 47
Hard drives 48
Handling hard disk drives 48
Memory 49
Supported DIMM configurations 49

BIOS errors and warnings 49
DIMM installation guidelines 49
DIMM installation order 50
Power supply 51
Power supply specifications 51
Power consumption and heat dissipation 52
Resetting the power supply 52
Thermal sensors 53

4 Diagnostics and troubleshooting 54
Calling support 55
Locating ID labels 56
Locating warranty information 56
Diagnosis guidelines 57
Diagnosis at startup 57
Diagnosis during operation 57
Troubleshooting checklist 58
HP troubleshooting resources and tools 59
HP Support Assistant 59
E-support 59
Troubleshooting a problem 60
Instant Support and Active Chat 60
Customer Advisories, Customer and Security Bulletins, and Customer Notices .. 60
Product Change Notifications 60
Helpful hints 61
At startup 61
During operation 61
Customer self-repair 62
Troubleshooting scenarios and solutions 63
Solving minor problems 63
Solving hard drive problems 65
Solving display problems 66
Solving audio problems 72
Solving printer problems 73
Self-troubleshooting with HP Vision Diagnostics 74
Overview 74
Downloading and accessing HP Vision Diagnostics 75
Accessing HP Vision Diagnostics on the computer 75
Creating and using a bootable USB key 76
Creating and using a bootable DVD 76
Using the HP Memory Test utility 76

User interface 77
Survey tab 78
Test tab 79
Status tab 80
History tab 80
Errors tab 81
Help tab 81
Saving and printing information in HP Vision Diagnostics 82
Diagnostic codes and errors 83
Diagnostic LED and audible (beep) codes 83
LED color definitions 86
POST error messages 87

5 Configuring password security and resetting CMOS 93
Preparing to configure passwords 93
Resetting the password jumper 93
Clearing and resetting the CMOS 95
Using the CMOS button to reset CMOS 95
Using Computer Setup (F10) Utility to reset CMOS 96

Appendix A Linux technical notes 97
System RAM 97
Audio 97
Network cards 98
Hyper-Threading Technology 98
NVIDIA Graphics Workstations 99

Appendix B Configuring RAID devices 100
Configuring SATA RAID in Windows 100
Configuring the system BIOS to enable embedded SATA RAID functionality 101
Creating RAID volumes 102
Software RAID solution 103
Software RAID considerations 103
Performance considerations 103
Configuring software RAID 104

Appendix C System board designators 105
Main system board 105
Rear I/O board 106
Side I/O board 107

1 Hardware overview

This chapter presents an overview of workstation hardware components. It includes these topics:

Topics
System board architecture on page 7
Chassis components on page 5
Front and bottom components on page 2
Side components on page 3
Rear components on page 4
Workstation specifications on page 8

Front and bottom components

Figure 1-1 Front and bottom components

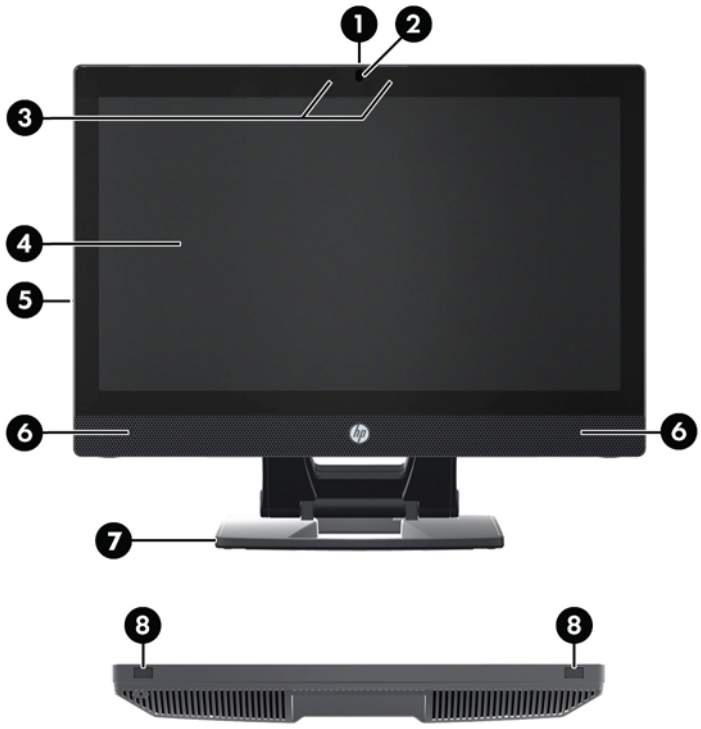


Table 1-1 Component descriptions

1	Camera angle adjustment dial	**5**	Serial number pull-out card
2	Camera	**6**	Speakers
3	Left and right digital microphones	**7**	Stand
4	Display	**8**	Chassis latches (bottom view)

Side components

Figure 1-2 Side components

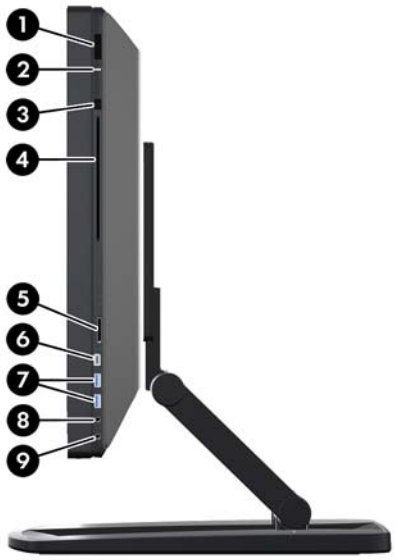


Table 1-2 Component descriptions

1		Power button	**6**		IEEE-1394a FireWire® connector
2		Hard drive activity light	**7**	SS	USB 3.0 connectors (2)
3		Slot-load optical drive eject button and activity LED	**8**		Headphone connector
4		Slot-load optical drive	**9**		Microphone connector
5		xD/MMC/MS/SD card reader			

Rear components

Figure 1-3 Rear components (excluding stand)

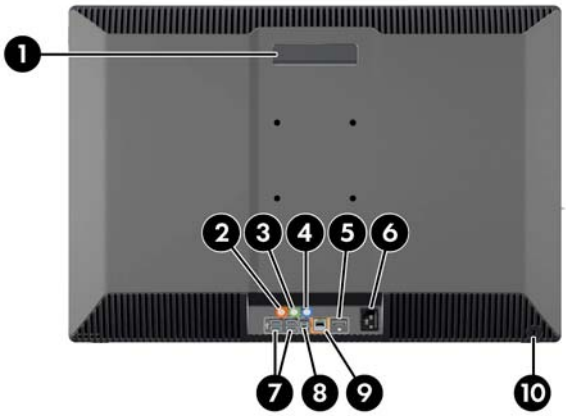


Table 1-3 Component descriptions

1		Handle	**6**		Power cord connector
2	Sub	Subwoofer connector (orange)	**7**		USB 2.0 connectors (4)
3		Audio line-out connector (green)	**8**	S/PDIF	Optical S/PDIF audio output
4		Audio line-in connector (blue)	**9**		RJ-45 network connector
5	DisplayPort	DisplayPort connector (output/input)	**10**		Cable lock slot

Chassis components

Figure 1-4 Chassis components

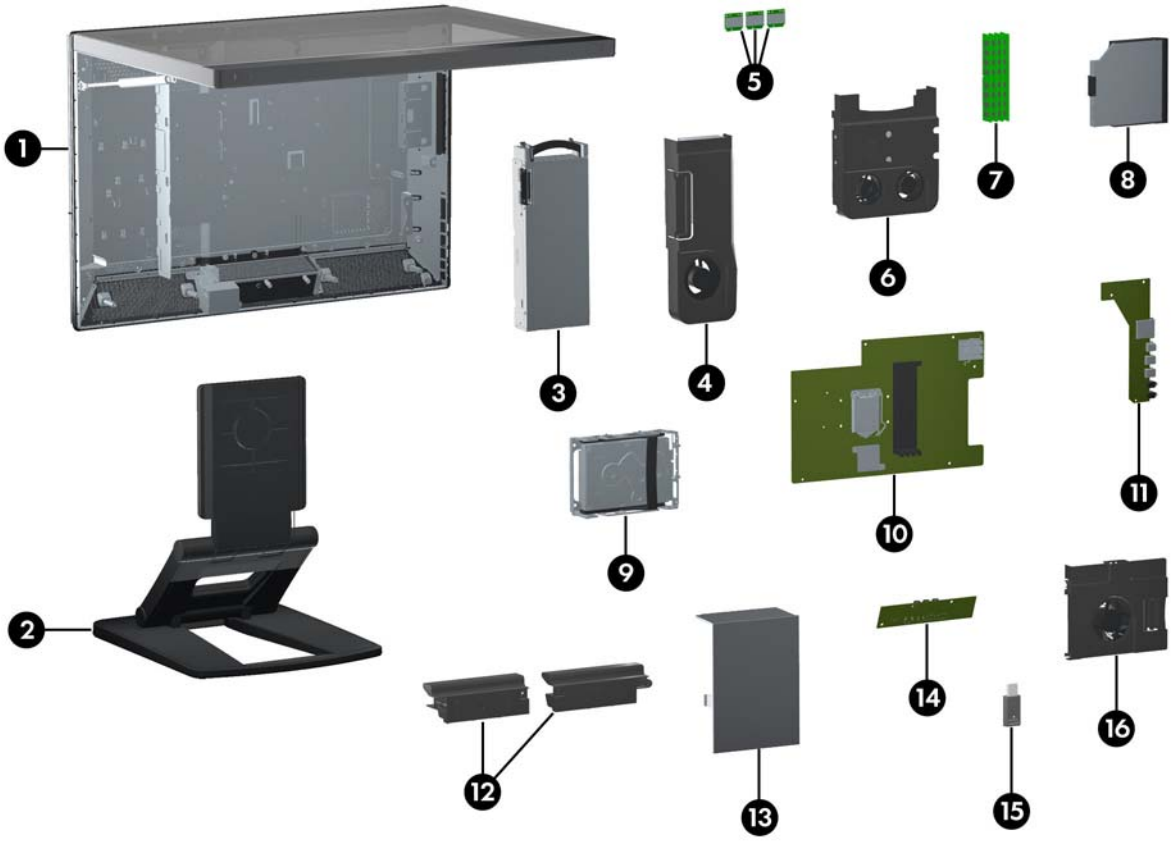


Table 1-4 Component descriptions

1	Chassis and display assembly	**7**	Memory modules (DIMMs)	**13**	Graphics filler block (installed if graphics card assembly is not ordered)
2	Stand	**8**	Slot-load optical drive	**14**	Rear I/O board
3	Power supply	**9**	Hard drive and carrier assembly	**15**	Wireless keyboard/mouse USB receiver
4	Graphics card assembly	**10**	System board	**16**	Memory fan
5	Mini PCI cards	**11**	Side I/O board		
6	Processor (CPU) heatsink	**12**	Speakers		

System board components

The following figure and table describe the system board component layout.

Figure 1-5 System board component locations

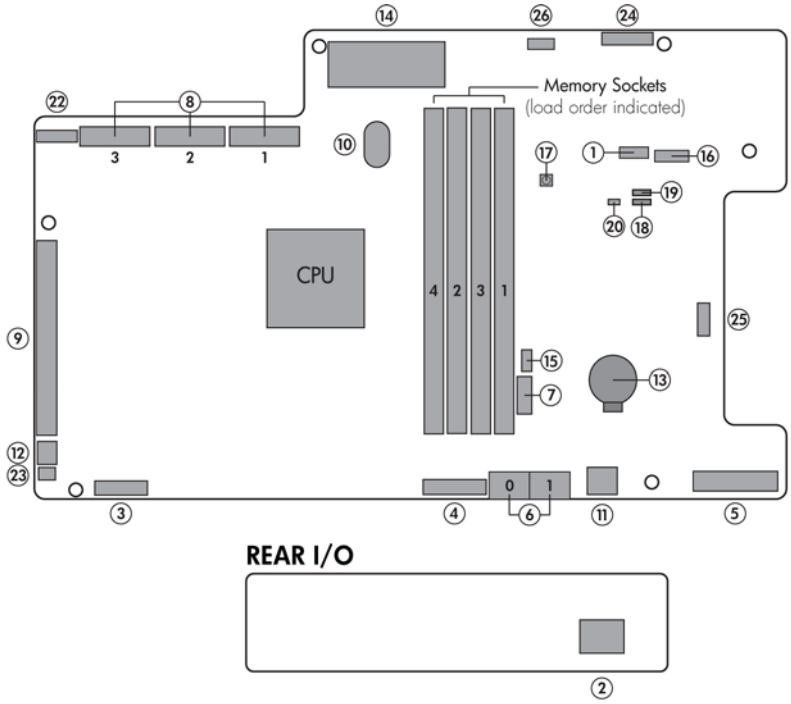


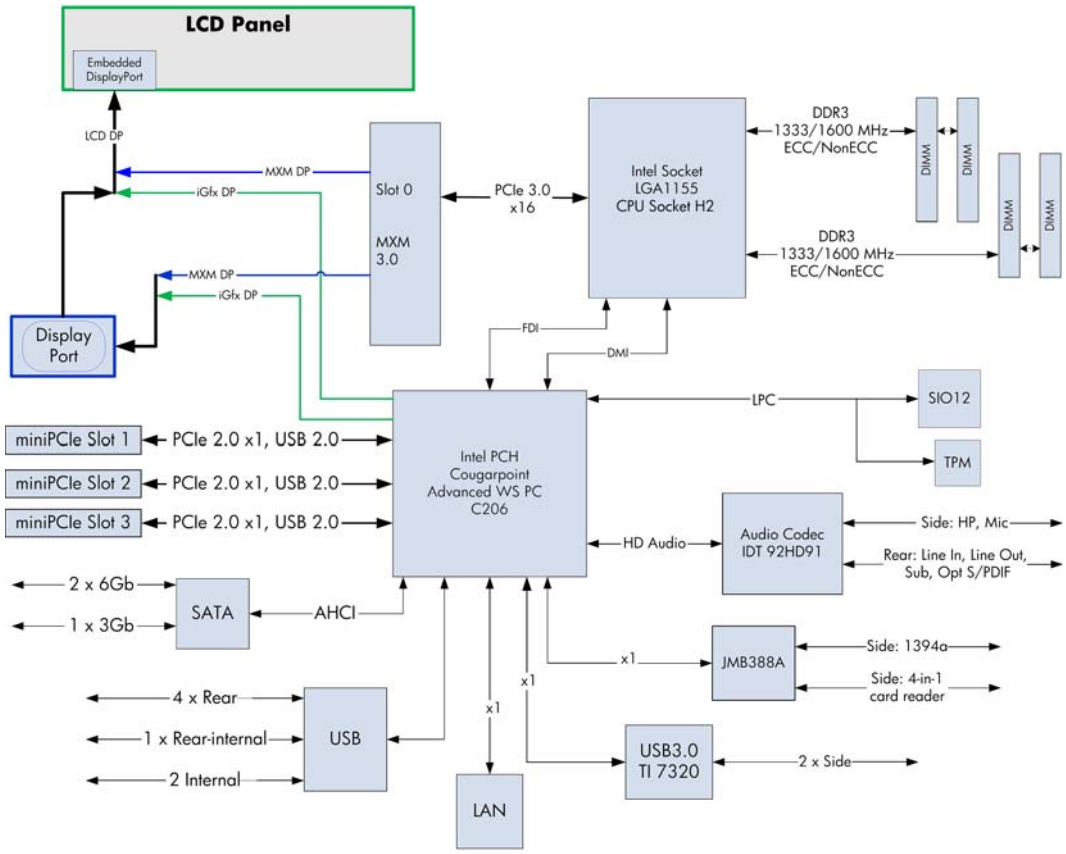
Table 1-5 Component descriptions

I/O		Cooling		Service	
1	Internal USB header	**10**	CPU fan	**17**	Clear CMOS
2	Internal USB	**11**	Memory fan	**18**	Crisis Recovery jumper
3	Rear DP/LAN	**12**	MXM fan	**19**	ME/AMT flash override jumper
4	Rear USB/Audio		**Power**	**20**	Password jumper
5	Side I/O	**13**	Battery		**Misc**
	SATA	**14**	Main power	**22**	Display
6	HDD SATA 6Gb/s.	**15**	ODD power	**23**	Hood sensor
7	ODD SATA (3Gb/s)	**16**	Power button	**24**	LCD Sync/backlight
	PCI/PCIe			**25**	Speakers
8	Mini PCIe2 x1 (3)			**26**	Webcam/MIC
9	MXM Graphics				

System board architecture

The following figure shows the system board block diagram.

Figure 1-6 System board block diagram



Workstation specifications

Physical characteristics and technical specifications

	HP Z1 Workstation	
Weight	With stand	21.3 kg (47.0 lbs)
	Without stand	15.4 kg (34.0 lbs)
	Stand only	5.9 kg (13.0 lbs)
Dimensions	Upright, including stand	**Height**: 58.42 cm (23.0 in) **Width**: 66.04 cm (26.0 in) **Depth**: 41.91 cm (16.5 in)
	Upright, excluding stand	**Height**: 45.72 cm (18.0 in) **Width**: 66.04 cm (26.0 in) **Depth**: 8.13 cm (3.2 in)
Processor technology	Intel® Series C206 chipset with: • Support for the Intel® Xeon® Processor E3 Family or 2nd generation Intel® Core™ processors up to 95W • Integrated 2-channel memory controller • Microarchitecture improvements • Integrated graphics (some models) • Advanced Vector Extensions (AVX) to increase floating point performance • Intel DMI2 interface connecting the processor to the I/O controller	
Power supply	• 400W, 90% efficient, 80 PLUS Gold, compatible with ENERGY STAR® requirements • Supports European Union ERP Lot 6 tier2 power limit of less than 0.5W in off mode	
Memory technology	• Dual in-line memory modules (DIMMs) based on DDR3 1600MHz technology • Supports error checking and correcting (ECC) and non-ECC DIMMs • Two direct-attach memory channels enable low-latency access and fast data transfer for improved performance • Up to 32 GB system memory (8 GB DIMMs) • 1600 MHz 2, 4, 8 GB ECC unbuffered DIMM • 1600 MHz 2 GB non ECC unbuffered DIMM **NOTE:** The processor controls the speed of the memory. If the processor only supports 1333 MHz memory, then memory will run at 1333 MHz regardless of the speed capability of the DIMMs.	

	HP Z1 Workstation
Graphics	• One MXM graphics card assembly (optional) that has PCIe x16 link (can support up to Gen3) **NOTE:** The speed of the PCIe x16 link is determined by the processor and the graphics card. If the processor or the graphics card only support PCIe Gen2 speeds, the MXM PCIe x16 link will run at Gen2 speeds. • Supports Intel HD Graphics 2000 or P3000 (depends on processor type) • Can simultaneously drive the internal display and a monitor connected to the external DisplayPort **NOTE:** If an MXM graphics card is installed, the Intel HD Graphics is disabled. **NOTE:** Intel Core processors provide Intel HD Graphics 2000; Intel Xeon processors with model designations that end in "--5" provide Intel HD Graphics P3000.
I/O technology	• RAID configurations for SATA RAID levels 0, 1 • External and internal USB 2.0 ports • External USB 3.0 ports • HP Low Power State technology enabled • Supports European Union ERP Lot 6 tier2 power limit of less than 0.5W in off mode • RJ45 for LAN • DisplayPort (output/input) • Webcam • Digital Microphone array • Headphone and microphone • Line in and line out • Subwoofer • Optical S/PDIF output • External 1394a powered port • 4-in-1 card reader

Environmental specifications

Table 1-6 HP Workstation environmental specifications

Temperature	**Operating**: 5°C to 35°C (40°F to 95°F) **Non-operating**: -40°C to 60°C (-40°F to 140°F) **NOTE:** The ambient upper limit of 35°C is good up to 1524 m (5000 ft) elevation. Derate by 1°C for every 305 m (1000 ft) above 1524 m (5000 ft). For example, at 3,048 m (10,000 ft), the upper ambient air temperature limit is 30°C.
Humidity	**Operating**: 8% to 85% relative humidity, non-condensing **Non-operating**: 8% to 90% relative humidity, non-condensing
Altitude	**Operating:** 0 to 3,048 m (10,000 ft) **Non-operating**: 0 to 9,144 m (30,000 ft)
Shock	**Operating**: ½-sine: 40g, 2-3ms **Non-operating**: • ½-sine: 160 cm/s, 2-3ms (~100*g*) • square: 422 cm/s, 20*g* **NOTE:** Values represent individual shock events and do not indicate repetitive shock events.
Vibration	**Operating random**: 0.5*g* (rms), 5-300 Hz **Non-operating random**: 2.0*g* (rms), 10-500 Hz **NOTE:** Values do not indicate continuous vibration.

Location and ventilation

Proper ventilation for the system is important for workstation operation. To ensure adequate ventilation:

- Operate the workstation on a sturdy, level surface.
- Provide at least:
  - 12 cm (4.7 in) clearance at the front, back, top, and bottom of the workstation
  - 16 cm (6.3 in) clearance on the right side for the optical drive
- Ensure that the ambient air temperature surrounding the workstation falls within the specified limits (see Environmental specifications on page 10).
- Never restrict the incoming or outgoing airflow of the workstation by blocking any vents or air intakes.

2 System management

This section describes the tools and utilities that provide system management for the workstation. It includes these topics:

Topics
Power management features on page 11
BIOS ROM on page 12
Computer Setup (F10) Utility on page 13
Desktop management on page 23

Power management features

ERP compliance mode

This computer provides ERP compliance mode capability.

When enabled, the computer shuts down to the lowest possible power state. The computer must then be turned on with the power button. One of the effects is that "wake on LAN" is disabled.

When disabled, the computer powers down conventionally.

Enabling ERP compliance mode	1. Press F10 during startup. 2. Using the arrow keys, select the **Power > Hardware Power Management > S5 Maximum Power Savings**, then select **Enable**. 3. Press F10 to accept the change. 4. Select **File > Save Change and Exit**, and then press Enter to accept the change.
Disabling ERP compliance mode	1. Press F10 during startup. 2. Using the arrow keys, select **Power > Hardware Power Management > S5 Maximum Power Savings**, then select **Disable**. 3. Press F10 to accept the change. 4. Select **File > Save Change and Exit**, and then press Enter to accept the change.

Hyper-Threading Technology (HTT)

This computer supports HTT, an Intel-proprietary technology that improves processor performance through parallelization of computations (doing multiple tasks at once).

The operating system treats an HTT-enabled processor as two virtual processors, and shares the workload between them when possible. This feature requires that the operating system support multiple processors and be specifically optimized for HTT.

Use the Computer Setup (F10) Utility to enable HTT.

Go to http://www.hp.com/go/quickspecs to determine if your CPU supports HTT.

SATA Power Management

SATA Power Management enables or disables SATA bus and/or device power management.

Intel Turbo Boost Technology

The HP Z Workstation series supports Intel® Turbo Boost Technology.

This feature enables the CPU to run at a higher than normal rate. When all CPU cores are not necessary for the workload, inactive cores are turned off and power is diverted to the active cores to increase their performance.

Turbo Boost is enabled and disabled with the Computer Setup (F10) Utility.

Go to http://www.hp.com/go/quickspecs to determine if your CPU supports Turbo Boost.

HP Cool Tools

HP workstations and computers installed with Windows include additional software tools. To access or learn more about these tools that can enhance the computer experience:

1. Double-click the **HP Cool Tools** icon on the desktop.
2. To learn more about an HP Cool Tool application, just click on the application's "Learn More" link.
3. To install or launch the applications, select the appropriate application and follow the instructions given.

BIOS ROM

The BIOS ROM is a collection of machine language applications stored as firmware in ROM. It includes functions such as Power on Self Test (POST), PCI device initialization, Plug and Play support, power management, and Computer Setup (F10) Utility.

Go to http://www.hp.com/go/quickspecs to review the latest BIOS ROM specifications.

Computer Setup (F10) Utility

This section includes these topics:

Topics
Computer Setup (F10) Utility functionality on page 13
Accessing Computer Setup (F10) Utility on page 14
Computer Setup (F10) Utility menu on page 15

Computer Setup (F10) Utility functionality

Computer Setup (F10) Utility enables you to perform the following tasks:

- Update BIOS using a USB device.
- Change factory default settings and set or change the workstation configuration, which might be necessary when you add or remove hardware.
- Determine if all devices installed on the workstation are recognized by the system and functioning.
- Determine information about the operating environment of the workstation.
- Solve system configuration errors that are detected but not fixed during the Power-On Self-Test (POST).
- Establish and manage passwords and other security features.
- Establish and manage energy-saving time-outs.
- Set the workstation date and time, and modify or restore factory default settings.
- Set, view, change, or verify the workstation configuration, including settings for CPU, graphics, memory, audio, storage, communications, and input devices.
- Modify the boot order of installed mass storage devices such as SATA, optical disk drives and network drives.
- Configure the boot priority of SATA hard-drive controllers.
- Enable or disable Network Server Mode. This mode enables the workstation to start the operating system when the power-on password is enabled with or without a keyboard or mouse attached. When the keyboard and mouse are attached to the workstation, they remain locked until the power-on password is entered.
- Enable or disable POST Messages to change the display status of POST messages. POST Messages suppresses most messages, such as memory count, product name, and other non-error text messages. If a POST error occurs, the error is displayed regardless of the mode selected. To manually enable POST Messages during POST, press any key except F1 through F12.
- Specify an Ownership Tag, which is displayed on the screen when the workstation is started or restarted.
- Specify the Asset Tag or property identification number assigned to this workstation.

- Enable power-on password prompts during system restarts (warm-starts) and power on.
- Hide or show the integrated I/O functionality, including serial, USB, or parallel ports, audio, or embedded NIC. Hidden devices are inaccessible, which increases system security.
- Enable or disable removable media boot ability.
- Enable or disable removable media write ability (if supported by hardware).
- Replicate the workstation setup by saving system configuration information on CD and restoring it on workstations.
- Execute self-tests on specified SATA hard disk drives (if supported by the drive).

Accessing Computer Setup (F10) Utility

To access Computer Setup (F10) Utility:

1. Power on or restart the workstation.
2. When the display is active and **Press the Esc key for Startup Menu** appears at the bottom of the screen, press F10 or Esc.

   If you do not press F10 or Esc at the appropriate time, try again. Turn the workstation off, then on, and press F10 again to access the utility. You can also press Ctrl + Alt + Delete before starting if you miss the opportunity to press F10.
3. Select the language from the list and press the Enter key.

   In the Computer Setup (F10) Utility menu, five headings are displayed: File, Storage, Security, Power, and Advanced.

NOTE: The option for selecting the language is available on first boot only.

4. Use the left and right arrow keys to select the appropriate heading, use the up and down arrow keys to select an option, and then press Enter.
5. Choose from the following:
   - To apply and save changes, select **File > Save Changes and Exit**, and then press Enter to accept the changes.
   - To remove changes you have made, select **Ignore Changes and Exit**, and then press Enter to acknowledge the cancellation.
   - To reset to factory settings, select **File > Default Setup > Restore Factory Settings as Default**. Press Enter to accept the changes, and then select **Apply Defaults and Exit**. This restores the original factory system defaults.

CAUTION: Do not power off the workstation while saving Computer Setup (F10) Utility changes, because the Complementary Metal-Oxide Semiconductor (CMOS) nonvolatile storage could become corrupted. Power off after you exit the F10 Setup screen.

Computer Setup (F10) Utility menu

The following table describes the functions available in the Computer Setup (F10) Utility menu.

NOTE: With new BIOS releases, the following content is subject to change, so the menu might be different than shown.

Table 2-1 Computer Setup (F10) Utility menu descriptions

Heading	Option	Description

File	System Information	Displays the following system characteristics:
		• Product Name
		• SKU Number
		• Processor Type
		• Processor Speed
		• Processor Stepping
		• Cache Size (L1/L2/L3)
		• Memory Size
		  ◦ Channel A
		  ◦ Channel B
		• Integrated MAC
		• System BIOS
		• Chassis serial number
		• Asset Tracking Number
		• ME Firmware Version
		• ME Management Mode
		• Boot Block Date

	About	Displays copyright information.
	Set Time and Date	Enables you to set system time and date.
	Flash System ROM	Enables you to upgrade the BIOS from a ROM image on CD or USB.
	Replicated Setup	Provides these options: • Save to Removable Storage Device—Saves the workstation configuration, including CMOS, in the qsetup.txt file. This file can be saved to a USB device or other storage media. • Restore from Removable Storage Device—Restores the workstation configuration from a USB device or other storage media.

Table 2-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
	Default Setup	Provides these options: • Save Current Settings as Default—Saves the current settings as default settings for the next operation. • Restore Factory Settings as Default—Restores the factory settings as the default settings for the next operation.
	Apply Defaults and Exit	Restores the default settings defined in Default Setup.
	Ignore Changes and Exit	Exits workstation setup without applying or saving changes.
	Save Changes and Exit	Saves changes to system configuration and exits the workstation setup.
Storage	Device Configuration	Lists installed non-SCSI storage devices (except SATA devices) and provides options for obtaining specific information about each device: • Hard Disk SATA0 • SATA2 (Blu-Ray) — Shows the default settings Mode (BR), Firmware, Serial Number, Connector Color) • SATA2 (DVD) — Shows the default settings Mode (DVD), Firmware, Serial Number, Connector Color). • Default Values (SATA defaults) ◦ Translation Mode—Enables the BIOS to determine the translation mode used to configure a formatted SATA or USB mass storage device. This prevents you from needing to know how the mass storage device was formatted. Options are Automatic, Bit Shift, LBA Assisted, User (Cylinders, Heads, Sectors), and Off. Automatic is the default. Ordinarily, you should not change the translation mode selected by the BIOS. If the selected translation mode is not compatible with the translation mode that was active when the drive was partitioned and formatted, the data on the disk is inaccessible.
	Storage Options	Provides these options: • Removable Media Boot—Enables and disables the ability to start the workstation from removable media. • SATA Emulation—Sets the SATA emulation mode with the following options: ◦ RAID + AHCI—Both the RAID and AHCI OPROMs execute. This emulation mode is the default and offers the best performance and most functionality. ◦ IDE—Offers standard SATA supports (four ports only).
	DPS Self-text	Select a drive—Lets you execute self-tests on SATA hard drives capable of performing Drive Protection System (DPS) self-tests. **NOTE:** This selection appears only when the system has one or more drives capable of performing the DPS self-tests.

Table 2-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
	Boot Order	Enables you to configure the boot orders by physically reordering the menu entries. The following is the default boot order presented in the menu: • EFI Boot Sources ◦ USB Floppy/CD ◦ USB Hard Drive ◦ ATAPI CD/DVD Drive • Legacy Boot Service ◦ ATAPI CD/DVD Drive ◦ USB Floppy/CD ◦ Hard Drive — USB Hard Drive — *Hard Drive Name* ◦ Network Controller (This option is only available if the workstaion is connected to a network.) Use the arrow keys to move the cursor to the desired device, and then perform one of the following actions: • Press Enter to select the device, then use the arrow keys to move that device up or down in the boot order. Press F10 to accept the new boot order. • Press F5 on a selected device to enable or disable the device from consideration as a bootable device. • Press Enter and the selected device will be de-selected. MS-DOS drive lettering assignments might not apply after an operating system other than MS-DOS has started. Boot devices can be disabled in the boot order process. These order changes are stored in the physical ROM when the F10 Setup changes are confirmed with File > Save Changes and Exit. You can temporarily override the boot order. To start one time from a device other than the default device specified in Boot Order, restart the workstation and press F9 when the F9=Boot Menu message appears on the screen. After POST completes, a list of bootable devices is displayed. Use the arrow keys to select the preferred bootable device and press Enter. The workstation then starts from the selected non-default device for this one time.
Security	Setup Password	Enables you to set and enable a setup password for the administrator. If you create a setup password, you must use it to change workstation setup options, to flash the ROM, and to make changes to certain Plug and Play settings under Windows.
	Power-On Password	Enables you to set and enable the power-on password.

Table 2-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
	Password Options	This option becomes available when you create a setup and/or power-on password. It provides these options: • Lock Legacy Resources—Prevents the operating system from changing resources to serial, parallel, or diskette controller. • Setup Browse Mode—Enables read-only functionality for password info. • Password Prompt on F9 & F12—Enables a password prompt on a warm boot. • Network Server Mode—Enables network server mode.
	Device Security	Makes the following devices available or hidden to the workstation: • Embedded security device • Internal webcam device • 1394 / cardreader controller • Texas Instruments USB3 controller • System audio • Network controller • SATA0 • SATA1 • SATA2 For each device (except Embedded Security Device), **Device Available** is the default setting and allows the operating system to access the device. **Device Hidden** makes the device unavailable; it is disabled by the BIOS and cannot be enabled by the operating system. **NOTE:** An entry for enabling DriveLock appears in the setup menu if the workstation has a DriveLock-compatible hard disk drive.
	USB Security	Set workstation USB ports to Enabled/Disabled: • Side USB Ports—(1–2) • Rear USB Ports—(1–4) • Internal USB Port
	Slot Security	Lets you enable or disable any PCI Express slot.
	Network Boot	Enables or disables the ability to boot to the network using the F12 key or the boot order.
	System IDs	Provides these options: • Asset Tag—A 16-byte string identifying the workstation. • Ownership Tag—An 80-byte string identifying ownership of the workstation. This tag appears on the screen during POST. • Universal Unique Identifier (UUID)—Can only be updated if the current chassis serial number is invalid. (These ID numbers are normally set in the factory and are used to uniquely identify the workstation.) • Keyboard—Enables you to set the keyboard locale for System ID entry.

Table 2-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
	Master Boot Record Security	Enable or Disable—This option is for advanced users. When Master Boot Record (MBR) Security is enabled, the BIOS prevents any changes being made to the MBR of the current bootable disk while in MS-DOS or Windows Safe Mode. **NOTE:** Most operating systems control access to the MBR of the current bootable disk; the BIOS cannot prevent changes that may occur while the operating system is running.
	System Security	Provides these options: • Data Execution Prevention—Enables or disables Data Execution Prevention mode in the CPUs. This mode prohibits code from running in pages that were set up as data pages, and prevents attacks such as buffer overflows. Operating system support is required for this feature. • Virtualization Technology (VTx)—Enables or disables Intel Virtualization Technology to increase workstation performance. • Intel(R) (VTd)—(Enabled or Disabled) Controls the underlying processor and chipset features needed to support a virtual appliance. To enable this feature you must enable: • Interrupt Remapping—Enables or disables...only available when Intel(R) (VTx) is enabled. • Coherency Support—Enables or disables...only available when Intel(R) (VTx) is enabled. • ATS Support—Enables or disables...only available when Intel(R) (VTx) is enabled. • Pass-through DMA—Enables or disables...only available when Intel(R) (VTx) is enabled. • Embedded Security Device—This option becomes available if Embedded Device is set to Available under Device Security. **NOTE:** Embedded Security Device must be set to Device Available in the Device Security menu, and you must create a Setup Password, in order to configure the Embedded Security Device. Embedded Security Device—(Hidden or Available) turns the Trusted Platform Mechanism (TPM) on and off. Device Hidden is the default. If this option is made available, the following options become available: ◦ Power-On Authentication Support—Enables and disables an authentication feature that requires you to enter a TPM user key password to start the workstation. This feature uses the TPM to generate and store the authentication password. ◦ Reset Authentication Credential—Resets the authentication functionality and clears authentication credentials. To enable the Embedded Security Device and to access any security features associated with the device, you must enter a setup password. Setting a device to Available enables the operating system to access the device. Hidden makes the device unavailable. It is disabled by the BIOS and cannot be enabled by the operating system.

Table 2-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
		CAUTION: Choosing Reset to Factory Settings may result in significant data loss. The embedded security device is a critical component of many security schemes. Erasing the security keys prevent access to data protected by the Embedded Security Device. • OS Management of Embedded Security Device—Enables or disables the ability of the operating system to control the TPM device, including turning it on and off, initializing it, and resetting it. ◦ Reset of Embedded Security Device through OS—Enables or disables the ability of the operating system to reset the TPM. Available only when OS Management of Embedded Security Device is enabled.
	DriveLock Security	Lets you assign or modify a master password or user password for hard drives. When enabled, this feature prompts the user to provide one of the DriveLock passwords during POST. If the user does not successfully enter one of the passwords, the hard drive remains inaccessible until one of the passwords is successfully entered during a subsequent cold-boot sequence. **NOTE:** This selection appears only when the system includes at least one drive that supports the DriveLock feature.
	Secure Boot Configuration	• Legacy Support—Enable/Disable • Secure Boot—Enable/Disable • Key Management ◦ Clear Secure Boot Keys—Clear/Don't Clear ◦ Key Ownership—HP Keys/Custom Keys • Fast Boot—Enable/Disable
Power	OS Power Management	Enables or disables: • Runtime Power Management—(Enable or Disable) • Turbo Mode—(Enable or Disable) • Idle Power Savings—Extended (default) or Normal; extended mode reduces processor power consumption when the CPU is idle • Unique Sleep State Blink Rates—(Enable or Disable)
	Hardware Power Management	Enables or disables: • SATA Power Management • S5 Maximum Power Savings
	Thermal	Enables you to set the rate of the system fan when the CPU is in idle (Fan Idle Mode).

Table 2-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
Advanced[2]	Power-On Options	Enables you to set the following: • POST Messages—Enables or disables the splash screen during POST. • Press the ESC key for Startup Menu • Option ROM[1] prompt (Enable or Disable)—Enabling this feature causes the workstation to display a message before loading options ROMs. • After Power Loss (On, Off, Last State)—Enabling this option directs the previous state to be the default. • POST Delay (in seconds) (5, 10, 15, 20, None)—Adds a specified delay to the POST process. This delay is sometimes needed for hard disk drives on some expansion cards that spin up slowly (so slowly that they are not ready to start by the time POST is finished). The POST delay also gives you time to select F10 to enter Computer Setup (F10) Utility. • Remote Wakeup Boot Source—Enables you to set the remote wakeup boot source as: ◦ Local Hard Drive ◦ Remote Server • System Recovery Boot Support—(Disabled/Enabled) • Bypass F1 Prompt on Configuration Changes
	BIOS Power-On	Enables you to disable or specify a weekday and time for BIOS power-on.
	Bus Options	Configures graphics cards per workstation slots. In multi-graphics card configurations, this option designates one card as primary graphics, and the other card as secondary graphics. • PCI SERR# Generation (Enabled/Disabled)—Controls PCI SERR# generation for ill-behaved PCI add-in cards (that can generate SERR# spuriously) • PCI VGA Palette Snoop (Disabled/Enabled)—Controls PCI VGA Palette Snooping for compatibility purposes • PCI Latency Timer—(32/64/128/160/192/224/248). 128 PCI Clocks is the default.
	Onboard Devices	Enables you to set resources (IRQ, DMA, I/O Rate) for or disable onboard system devices such as serial port and diskette controller. Operating system parameters generally override Onboard Devices settings.
	Device Options	Enables you to set the following device options: • Num Lock State at Power-On (On or Off) • Internal speaker—(Enable or Disable) • NIC Option ROM[1] Download (Enable or Disable) • SATA RAID Option ROM[1] Download (Enable or Disable) • Multi-processor (Activates a single core.)—(Enable or Disable) • Hyper-Threading—(Enable or Disable) • CECP Mode—(Enable or Disable)

Table 2-1 Computer Setup (F10) Utility menu descriptions (continued)

Heading	Option	Description
	Slot Settings	Enables you to set the following options for the Mini PCIe slots: • Slot 1 Option ROM Enabled/Disabled • Slot 2 Option ROM Enabled/Disabled • Slot 3 Option ROM Enabled/Disabled
	AMT Configuration	Lets you set the following AMT (Intel Active Management Technology) configuration options: • AMT (Enabled/Disabled)—Allows for remote discovery, repair and protection of networked workstations. Enabling the AMT function also enables the Network Controller (required for AMT to function correctly). • Unconfigure AMT/ME (Disabled/Enabled) 2—Restores AMT/ME defaults. When you save and exit after enabling this option, you will be prompted to complete the process upon restart. A Setup Password (even if one is set) does not need to be entered to complete the process. **NOTE:** Information about Intel AMT can be found at www.intel.com. • WatchDog Timer (Enabled/Disabled)—OS and BIOS WatchDog Timers can be set independently (in minutes): ◦ OS WatchDog TimerTimer—Sets the OS WatchDog Timer ◦ BIOS WatchDog Timer—Sets the BIOS WatchDog Timer

[1] Available on selected models

[2] These options should be used by advanced users only

Desktop management

This section summarizes capabilities, features, and key components of computer management, including:

Topics
Initial computer configuration and deployment on page 24
Installing a remote system on page 24
Copying a setup configuration to another computer on page 25
Updating and managing software on page 26
HP Client Management Solutions on page 26
Altiris Client Management Solutions on page 26
HP SoftPaq Download Manager on page 27
System Software Manager on page 27
ROM Flash on page 27
FailSafe Boot Block on page 28
Workstation security on page 28
Fault notification and recovery on page 38
Dual-state power button on page 39

NOTE: Support for specific features described in this guide can vary by model and software version.

Initial computer configuration and deployment

The computer includes a preinstalled system software image. After a brief software unbundling process, the computer is ready to use.

If you prefer to replace the preinstalled software image with a customized set of system and application software, you can deploy a customized software image by:

- Installing additional software applications after unbundling the preinstalled software image
- Using a disk cloning process to copy the contents from one hard disk drive to another

The HP Recovery Manager DVDs, ROM-based setup, and ACPI hardware provide further assistance with recovery of system software, configuration management and troubleshooting, and power management.

Support for specific features described in this guide can vary by model and software version.

The best deployment method depends on the information technology environment and processes.

Installing a remote system

Remote system installation enables starting and setting up the computer using software and configuration information on a network server. This feature is usually used for system setup and configuration and can be used to:

- Deploy a software image on new PCs
- Format a hard disk drive
- Install application software or drivers
- Update the operating system, application software, or drivers

To initiate a remote system installation, press F12 when **F12=Network Service Boot** appears in the lower right corner of the HP logo screen. Follow the onscreen instructions to continue the installation process. The default boot order is a BIOS configuration setting that can be changed to always attempt a network boot.

Copying a setup configuration to another computer

This section provides information about replicating the computer setup.

CAUTION: Setup configuration is model-specific. File system corruption can result if source and target computers are not the same model.

To copy a setup configuration:

1. Select a setup configuration to copy, and then restart the computer.
2. As soon as the computer powers on, press and hold F10 until you enter Computer Setup (F10) Utility. If necessary, press Enter to bypass the title screen.

   NOTE: If you do not press F10 at the appropriate time, you must restart the computer, and then press and hold F10 again to access the utility.

   If you are using a PS/2 keyboard, you might see a keyboard error message. Disregard it.
3. Select **File > Replicated Setup > Save to Removable Storage Device**. Follow the instructions on the screen to create the configuration file *cpqsetup.txt*and write it to a USB storage device.
4. Power off the computer you are configuring and insert the removeable USB media device containing the configuration file.
5. Power on the computer you are configuring.
6. Press and hold the F10 key until you enter Computer Setup (F10) Utility. If necessary, press Enter to bypass the title screen.
7. Select **File > Replicated Setup > Restore from Removable Storage Device**, and then follow the instructions on the screen.
8. Restart the computer when the configuration is complete.

Updating and managing software

HP provides several tools for managing and updating software on desktops and computers:

- HP Client Manager Software
- Altiris Client Management Solutions
- HP SoftPaq Download Manager
- System Software Manager

HP Client Management Solutions

HP Client Management Solutions (CMS), available for download from http://www.hp.com/go/easydeploy, are standards-based solutions for managing and controlling computers in a networked environment.

HP Client Management Solutions offers these services:

- Detailed views of hardware inventory for asset management
- PC health-check monitoring and diagnostics
- Proactive notification of changes in the hardware environment
- Web-accessible reporting of business-critical details such as thermal warnings and memory alerts
- Remote updating of system software such as device drivers and ROM BIOS
- Remote changing of boot order
- Configuration of system BIOS settings

Altiris Client Management Solutions

Altiris and HP have partnered to provide comprehensive, tightly integrated systems management solutions to reduce the cost of owning HP client PCs.

The HP CMS is the foundation for additional Altiris Client Management Solutions that address the following topics.

- Inventory and asset management
- Deployment and migration
- Help desk and problem resolution
- Software and operations management

Go to http://www.hp.com/go/Altiris_Solutions for information about:

- How HP CMS works
- Which solutions are compatible with the operating system
- How to download a fully functional, 30-day evaluation version of Altiris solutions

HP SoftPaq Download Manager

HP SoftPaq Download Manager is a free, easy-to-use interface for locating and downloading software updates for the HP client PC models in your environment. By specifying your models, operating system, and language, you can quickly locate, sort, and select the softpaqs you need. For more information, go to http://www.hp.com/go/sdm.

System Software Manager

System Software Manager (SSM) is a utility that is available on Windows computers. It enables you to update system-level software on multiple systems simultaneously. When executed on a PC client system, SSM detects hardware and software versions and then updates the software from a central repository, known as a *file store*. Driver versions supported by SSM are noted with a special icon in the software, on the driver download website, and on the Support Software CD.

To download the utility or to obtain more information about SSM, see http://www.hp.com/go/ssm.

ROM Flash

BIOS settings are stored on a programmable flash ROM. By establishing a setup password in Computer Setup (F10) Utility, you can protect unauthorized users from modifying the BIOS settings. This function is important to ensure the operating integrity of the computer.

To upgrade the BIOS, download the latest SoftPaq images from http://www.hp.com/support/workstation_swdrivers.

Remote ROM Flash

Remote ROM Flash allows system administrators to safely upgrade the ROM on remote HP computers from a centralized network management console, resulting in a consistent deployment of, and greater control over, HP PC ROM images over the network.

To use Remote ROM Flash, the computer must be powered on, or turned on using Remote Wakeup.

For more information about Remote ROM Flash and HPQFlash, see the HP Client Manager Software or System Software Manager sections at http://www.hp.com/go/ssm.

HPQFlash

The HPQFlash utility is used to locally update or restore the system ROM on PCs using a Windows operating system. For more information about HPQFlash, see http://www.hp.com/go/ssm, and enter the name of the computer.

FailSafe Boot Block

The FailSafe Boot Block enables BIOS recovery in the unlikely event of a ROM flash failure. For example, if a power failure occurs during a ROM upgrade, the Boot Block uses a flash-protected section of the ROM to verify a valid system ROM flash when power is restored to the computer.

If the system ROM is valid, the computer starts normally.

If the system ROM fails the validation check, the FailSafe Boot Block provides enough support to start the computer from a BIOS image CD created from a SoftPaq. The BIOS image CD programs the system ROM with a valid image.

When Boot Block detects an invalid system ROM, the computer power LED blinks red eight times and the computer beeps eight times; then the computer pauses for two seconds. On some models, a Boot Block recovery mode message appears.

In preparation for system recovery, use the BIOS CD media file in the SoftPaq to create a BIOS image CD or USB key.

Recovering the computer from Boot Block Recovery mode

To recover the computer after it enters Boot Block recovery mode:

1. Remove any media such as USB keys or disks in the optical disk drives.
2. Insert a BIOS image CD into the DVD drive. You can also use USB media such as an HP DriveKey.
3. Power off, then power on the computer.

   If no BIOS image CD or USB media is found, you are prompted to insert one and restart the computer.

   If a setup password has been established, the Caps Lock light illuminates and you are prompted for the password.
4. Enter the setup password.

   If the computer starts from the boot media and successfully reprograms the ROM, three keyboard lights illuminate and a rising-tone series of beeps signals successful recovery.
5. Remove the boot media and power off the computer.
6. Restart the computer.

Workstation security

This section provides information about providing system security through asset tracking, password security, hard disk drive locking, and chassis locks.

Asset tracking

Asset tracking features provide asset tracking data that can be managed using HP Systems Insight Manager (HP SIM), HP Console Management Controller (CMC), or other systems-management applications.

Seamless, automatic integration between asset tracking features and these products enables you to choose the management tool that is best suited to the environment and to leverage investments in existing tools.

HP also offers several solutions for controlling access to valuable components and information:

- HP ProtectTools Embedded Security prevents unauthorized access to data, checks system integrity, and authenticates third-party users attempting system access.
- Security features such as ProtectTools and the Smart Cover Sensor (side access panel sensor) help prevent unauthorized access to the data and to the internal components of the computer.
- By disabling parallel, serial, or USB ports, or by disabling removable-media boot capability, you can protect valuable data assets.
- Memory Change and Side access panel sensor (Smart Cover Sensor) alerts can be forwarded to system management applications to deliver proactive notification of tampering with a computer's internal components.

ProtectTools, the Smart Cover Sensor, and the side access panel solenoid lock (Hood Lock) are available as options on select systems.

You can manage security settings as follows:

- Locally, with Computer Setup (F10) Utility
- Remotely, with HP CMS or HP System Software Manager (SSM), which enable the secure, consistent deployment and control of security settings from a simple command line utility

For more information about Computer Setup (F10) Utility, see Computer Setup (F10) Utility menu on page 15.

The following Computer Setup (F10) Utility features let you manage computer security.

Table 2-2 F10 security features overview

Feature	Purpose
Removable Media Boot Control	Prevents booting from removable media drives
Serial, Parallel, USB, or Infrared Interface Control	Prevents transfer of data through the integrated serial, parallel, USB, or infrared interface
Power-On Password	Prevents use of the computer until the password is entered (applies to initial system startup and restarts)
Setup Password	Prevents reconfiguration of the computer (through the Setup utility) until the password is entered
Network Server Mode	Provides unique security features for computers used as servers

SATA hard disk drive security

HP computers include the HP DriveLock facility for SATA hard disk drives to prevent unauthorized access to data.

⚠ **WARNING!** Enabling DriveLock can render a SATA hard disk drive permanently inaccessible if the master password is lost or forgotten. No method exists to recover the password or access the data.

DriveLock has been implemented as an extension to Computer Setup (F10) functions. It is only available when hard disk drives that support the ATA security command set are detected. On HP computers, it is not available when the SATA emulation mode is RAID+AHCI or RAID.

DriveLock is for HP customers for whom data security is a paramount concern. For such customers, the cost of a hard disk drive and the loss of the data stored on it is inconsequential when compared to the damage that could result from unauthorized access to its contents.

To balance this level of security with the need to address the issue of a forgotten password, the HP implementation of DriveLock employs a two-password security scheme. One password is intended to be set and used by a system administrator, while the other is typically set and used by the user.

No "back door" can be used to unlock the drive if both passwords are lost. Therefore, DriveLock is most safely used when the data contained on the hard disk drive is replicated on a corporate information system or is regularly backed up.

If both DriveLock passwords are lost, the hard disk drive is rendered unusable. For users who do not fit the previously defined customer profile, this might not be acceptable. For users who fit this profile, it might be a tolerable risk, given the nature of the data stored on the hard disk drive.

DriveLock applications

The most practical use of DriveLock is in a corporate environment. The system administrator would be responsible for configuring the hard disk drive, which involves setting the DriveLock master password and a temporary user password. If you forget the user password or if the equipment is passed on to another employee, the master password can be used to reset the user password and regain access to the hard disk drive.

HP recommends that corporate system administrators who enable DriveLock also establish a corporate policy for setting and maintaining master passwords. This should be done to prevent a situation where an employee sets both DriveLock passwords before leaving the company. In such a scenario, the hard disk drive is unusable and requires replacement. Likewise, by not setting a master password, system administrators might find themselves locked out of a hard disk drive and unable to perform routine checks for unauthorized software, other asset control functions, and support.

For users with less stringent security requirements, HP does not recommend enabling DriveLock. Users in this category include personal users, or users who do not maintain sensitive data on their hard disk drives as a common practice. For these users, the potential loss of a hard disk drive resulting from forgetting both passwords is much greater than the value of the data DriveLock protects.

Access to Computer Setup (F10) and DriveLock can be restricted through the setup password. By specifying a setup password and not giving it to users, system administrators can restrict users from enabling DriveLock.

Using DriveLock

When hard disk drives that support the ATA security command set are detected, DriveLock appears under the Security menu in the Computer Setup (F10) Utility menu. You are presented with options to set the master password and to enable DriveLock. You must provide a user password to enable DriveLock. Because the initial configuration of DriveLock is typically performed by a system administrator, a master password should be set first.

HP encourages system administrators to set a master password whether they plan to enable DriveLock or not. This gives the administrator the ability to modify DriveLock settings if the drive is locked in the future. After the master password is set, the system administrator can enable DriveLock or leave it disabled.

If a locked hard disk drive is present, POST requires a password to unlock the device. If a power-on password is set and it matches the device's user password, POST does not prompt the user to re-enter the password. Otherwise, the user is prompted to enter a DriveLock password.

For a cold start, use the master or user password. For a warm start, enter the same password used to unlock the drive during the preceding cold start.

Users have two attempts to enter a correct password. During cold start, if neither attempt succeeds, POST continues but the drive remains inaccessible. During a warm-start or restart from Windows, if neither attempt succeeds, POST halts and the user is instructed to cycle power.

Enabling DriveLock

To enable and set the DriveLock user password:

1. Power on or restart the computer.
2. As soon as the computer is powered on, repeatedly press the F10 key until Computer Setup (F10) Utility starts.

   If you do not press F10 at the appropriate time, you must restart the computer, then repeatedly press F10 again to access the utility.
3. Select **Security > DriveLock Security**.
4. For each DriveLock-capable drive, select a drive by pressing F10 to accept.
5. Under Enable/Disable DriveLock options, select **Enable**, and then press F10 to enable DriveLock for a specific drive.

NOTE: To set the DriveLock master password, select **Master**.

CAUTION: If you forget the DriveLock password, the drive is unusable.

6. Enter a new user password (1 to 32 characters long), and then press F10 to accept.
7. Enter the password again in the Enter New Password Again field. If you forget this password, the drive is rendered permanently disabled.
8. Select **File > Save Changes and Exit**, and then press Enter to accept the changes. After you press Enter, the computer performs a cold start before invoking the DriveLock function.

   When the computer starts, you are prompted to enter the DriveLock password for each DriveLock-capable drive for which you have set a password. You have two attempts to enter the password correctly. If the password is not entered correctly, the computer attempts to start anyway. However, the boot process most likely fails because data from a locked drive cannot be accessed.

   In a single drive computer, if the drive has DriveLock enabled, the computer might not be able to boot to the operating system, and might try to boot from the network or from another storage device (depending on the boot ordering options). Regardless of the outcome of the start attempts, the drive-locked drive remains inaccessible without the DriveLock password.

   In a two-drive computer that has a boot drive and a data drive, you can apply the DriveLock feature to the data drive only. In this case, the computer can always start, but the data drive is accessible only when the DriveLock password is entered.

   Cold starts require that you enter DriveLock passwords. However, DriveLock passwords are also required for warm starts. For example, if you boot to DOS and press Ctrl+Alt+Del, you must enter the DriveLock password before the computer completes the next start cycle. This warm-start behavior is consistent with the DriveLock feature.

Password security

The power-on password prevents unauthorized use of the computer by requiring the entry of a password to access applications or data when the computer is powered on or restarted. The setup password specifically prevents unauthorized access to the Computer Setup (F10) Utility and can also be used as an override to the power-on password. An administrator can enter the setup password at the prompt for the power-on password and gain access to the computer.

You can establish a network-wide setup password to enable the system administrator to log in to all network systems to perform maintenance without needing to know the power-on password.

Establishing a setup password using Computer Setup (F10) Utility

Establishing a setup password through the Computer Setup (F10) Utility prevents reconfiguration of the computer (through the use of Computer Setup (F10) Utility) until the password is entered.

To establish a setup password using the Computer Setup (F10) Utility menu:

1. Power on or restart the computer.
2. As soon as the computer is powered on, repeatedly press the F10 key until you enter Computer Setup (F10) Utility.

   If you do not press F10 at the appropriate time, you must restart the computer, then repeatedly press F10 again to access the utility.
3. Select **Security > Setup Password** and then follow the onscreen instructions.
4. Before exiting, select **File > Save Changes and Exit**.

Establishing a power-on password using computer setup

Establishing a power-on password through Computer Setup (F10) Utility prevents access to the computer when power is connected, unless you specify the password. When a power-on password is set, Computer Setup (F10) Utility presents Password Options in the Security menu. The password options include Network Server Mode and Password Prompt on Warm Boot.

When Network Server Mode is disabled, you must enter the password when the computer is powered on, when the key icon appears on the monitor. When Password Prompt on Warm Boot is enabled, you must enter the password. The password must also be entered each time the computer is restarted. When Network Server Mode is enabled, the password prompt is not presented during POST, but an attached PS/2 keyboard remains locked until you enter the power-on password.

To enable Network Server Mode, you must set a power-on password under **Advanced > Password Options**. This option enables the computer to start without requiring the power-on password, but the keyboard and mouse are locked until you enter the password. The keyboard LEDs rotate constantly when the computer is in locked mode.

To establish a power-on password through the Computer (F10) menu:

1. Power on or restart the computer.
2. As soon as the computer is powered on, repeatedly press the F10 key until you enter Computer Setup (F10) Utility.

   If you do not press F10 at the appropriate time, you must restart the computer, and then repeatedly press F10 again to access the utility.
3. Select **Security > Power-On Password**, and then follow the onscreen instructions.
4. Before exiting, select **File > Save Changes and Exit**.

Entering a power-on password

To enter a power-on password:

1. Restart the computer.
2. When the key icon appears on the monitor, enter the current password, and then press Enter.

Type carefully. For security reasons, the characters you enter do not appear on the screen.

If you enter the password incorrectly, a broken key icon appears. Try again. After three unsuccessful tries, you will enter the F10 setup screen with read-only permission. (See the Setup Browse Mode option under the Power-On options.)

Entering a setup password

If a setup password has been established on the computer, you will be prompted to enter it each time you run Computer Setup (F10) Utility.

To enter a setup password:

1. Restart the computer.
2. As soon as the computer is powered on, repeatedly press the F10 key until you enter Computer Setup (F10) Utility.

   If you do not press F10 at the appropriate time, you must restart the computer, then repeatedly press F10 again to access the utility.
3. When the key icon appears on the monitor, enter the setup password, and press Enter.

Type carefully. For security reasons, the characters you enter do not appear on the screen.

If you enter the password incorrectly, a broken key icon appears. Try again. After three unsuccessful tries, you must restart the computer before you can continue.

Changing a power-on or setup password

To change a power-on or setup password:

1. Restart the computer.
2. To change the power-on password, go to step 4.
3. To change the setup password, as soon as the computer is powered on, repeatedly press the F10 key until you enter Computer Setup (F10) Utility.

   If you do not press F10 at the appropriate time, you must restart the computer, then repeatedly press F10 again to access the utility.
4. When the key icon appears, enter the current password, a slash (/) or alternative delimiter character, the new password, another slash (/) or alternative delimiter character, and the new password again as shown:

   current password/new password/new password

   For information about the alternative delimiter characters, see National keyboard delimiter characters on page 36.

   Type carefully. For security reasons, the characters you enter do not appear on the screen.
5. Press Enter.

The new password takes effect the next time you power on the computer.

The power-on and setup passwords can also be changed using the Security options in Computer Setup (F10) Utility.

Deleting a power-on or setup password

To delete a power-on or setup password:

1. Power on or restart the computer.
2. Choose from the following:
   - To delete the power-on password, go to step 4.
   - To delete the setup password, as soon as the computer is powered on, press and hold F10 until you enter Computer Setup (F10) Utility. Press Enter to bypass the title screen, if necessary.

     If you do not press F10 at the appropriate time, you must restart the computer and then press and hold F10 again to access the utility.

     Use the appropriate operating system shutdown process.
3. When the key icon appears, enter the current password followed by a slash (/) or alternative delimiter character: *current password/.*

   For information about the alternative delimiter characters see the following section.
4. Press Enter.

National keyboard delimiter characters

Each keyboard meets country-specific requirements. The syntax and keys you use for changing or deleting passwords depend on the keyboard included with the computer.

Table 2-3 National keyboard delimiter characters

Language	Delimiter	Language	Delimiter	Language	Delimiter
Arabic	/	Greek	-	Russian	/
Belgian	=	Hebrew	.	Slovakian	-
BHCSY*	-	Hungarian	-	Spanish	-
Brazilian	/	Italian	-	Swedish/Finnish	/
Chinese	/	Japanese	/	Swiss	-
Czech	-	Korean	/	Taiwanese	/
Danish	-	Latin American	-	Thai	/
French	!	Norwegian	-	Turkish	.
French Canadian	é	Polish	-	U.K. English	/
German	-	Portuguese	-	U.S. English	/

* Bosnia-Herzegovina, Croatia, Slovenia, and Yugoslavia

Clearing passwords

If you forget the password, you cannot access the computer.

For instructions about clearing passwords, see **Configuring password security and resetting CMOS**.

Chassis security

Smart Cover Sensor

The Smart Cover Sensor is a combination of hardware and software technology that alerts you if the interior or the computer is accessed (provided the sensor has been configured in Computer Setup (F10) Utility). The sensor alerts you when the side panel is removed (desktop and tower models) or when the computer is opened (all-in-one models).

Three levels of protection are available:

Table 2-4 Smart Cover Sensor protection levels

Level	Setting	Description
Level 0	Disabled	Sensor * is disabled (default).
Level 1	Notify User	When the computer restarts, a message indicates that the computer has been opened or the access panel has been removed.
Level 2	Setup Password	When the computer restarts, a message indicates that the computer has been opened or the access panel has been removed. You must enter the setup password to continue.

* Smart Cover Sensor settings can be changed using Computer Setup (F10) Utility.

Setting the protection level

To set the Smart Cover Sensor protection level:

1. Power on or restart the computer.
2. During startup, press and hold the F10 key until you enter Computer Setup (F10) Utility. Press Enter to bypass the title screen, if necessary.

NOTE: If you do not press the F10 key at the appropriate time, you must restart the computer, and then press and hold the F10 key again to access Computer Setup (F10) Utility.

If you are using a PS/2 keyboard, you might see a keyboard error message. Disregard it.

3. Select **Security > Smart Cover > Cover Removal Sensor**, and follow the onscreen instructions.
4. Before exiting, select **File > Save Changes and Exit**.

Cable lock (optional)

To prevent theft, you can attach a keyed cable lock to the bottom left corner of the chassis. This cable lock attaches to the chassis and secures it to the work area.

Fault notification and recovery

Fault notification and recovery features combine innovative hardware and software technology to prevent the loss of critical data and minimize unplanned downtime.

If the computer is connected to a network that is managed by HP CMS, the computer sends a fault notice to the network management application. With HP CMS, you can also remotely schedule diagnostics to run on managed PCs and create a summary report of failed tests.

Drive Protection System

The Drive Protection System (DPS) is a diagnostic tool built into hard disk drives and is installed in select HP computers. The DPS helps diagnose problems that might result in unwarranted hard disk drive replacement.

When HP computers are built, each installed hard disk drive is tested using the DPS, and a permanent record of key information is written onto each drive. Every time the DPS is run, test results are written to the hard disk drive. The service provider can use this information to help diagnose conditions that required you to run the DPS software.

ECC fault prediction

When the computer encounters an excessive number of error checking and correcting (ECC) memory errors, it displays a local alert message. This message contains information about the errant DIMM, enabling you to take action before you experience noncorrectable memory errors. ECC DIMMs are standard on this computer.

Thermal sensors

Several thermal sensors in the HP Workstation regulate computer fans to maintain an acceptable, efficient chassis temperature.

Dual-state power button

With ACPI enabled, the power button can function as an on/off switch or as a button. This feature does not completely turn off power, but instead causes the computer to enter a low-power standby state. This enables you to go to standby without closing applications, and to return to the same operational state without any data loss.

Changing the power button configuration (Windows only)

Windows 7

1. Select **Start**, and then select **Control Panel > System and Security > Power Options**.
2. In the left pane, click **Choose what the power buttons do**.
3. Select the desired options.

If you choose Sleep or Hibernate, you can press the power button to initiate standby, and then press it again to exit standby and return to your work. To completely turn off the workstation, select **Start > Shut Down**.

CAUTION: To reduce the risk of data loss, do not use the power button to turn off the computer unless the system is unresponsive.

NOTE: If the computer is unresponsive, press and hold the power button for four seconds to completely turn off power to the computer.

Windows 8

1. Point to the upper-right or lower-right corner of the Start screen to display the charms.
2. In the Search field, type `control`.
3. On the left side of the screen select **Control Panel**, and then select **System and Security > Power Options**.
4. In Power Option Properties, select **Choose What the Power Button Does**.
5. Select the desired options.

3 Component replacement information and guidelines

This chapter provides warnings, cautions, information, and guidelines for removal and replacement procedures. It does not document the step-by-step procedures.

IMPORTANT: Removal and replacement procedures are now available in videos on the HP website.

Go to the HP Customer Self Repair Services Media Library at http://www.hp.com/go/sml.

This chapter includes these topics:

Topics
Warnings and cautions on page 41
Service considerations on page 42
Product recycling on page 43
Component replacement guidelines on page 45 • Battery on page 45 • Cable management on page 46 • CPU (processor) and CPU heatsink on page 47 • Expansion slots on page 47 • Hard drives on page 48 • Memory on page 49 • Power supply on page 51 • Thermal sensors on page 53

Warnings and cautions

WARNING! These symbols on any surface or area of the equipment indicate the following:

Presence of a hot surface or hot component. If this surface is contacted, the potential for injury exists. To reduce the risk of injury from a hot component, let the surface cool before touching.

Presence of an electrical shock hazard. To reduce the risk of injury from electrical shock, do not open any enclosed area marked with this symbol.

Product must always be lifted by two persons to avoid personal injury due to product weight.

WARNING! To reduce the risk of electric shock or damage to your equipment:

— Do not disable the power cord grounding plug. The grounding plug is an important safety feature.

— Plug the power cord in a grounded (earthed) outlet that is easily accessible at all times.

— Disconnect power from the equipment by unplugging the power cord from the electrical outlet.

WARNING! To reduce the risk of serious injury, read the *Safety & Comfort Guide*. It describes proper computer setup, posture, health, and work habits for computer users, and provides important electrical and mechanical safety information. This guide is located at http://www.hp.com/ergo.

WARNING! Do not use the front bezel as a handle or lifting point when lifting or moving the computer. Lifting the computer from the front bezel, or lifting it incorrectly, could cause the computer to fall, causing possible injury to you and damage to the computer. To properly and safely lift the computer, lift from the bottom of the computer.

CAUTION: Static electricity can damage the electronic components of the computer. To prevent damage to the computer, observe the following Electrostatic Discharge (ESD) precautions while servicing the computer:

— Discharge static electricity by briefly touching a grounded metal object before you begin.

— Work on a static-free mat.

— Wear a static strap to ensure that any accumulated electrostatic charge is discharged from your body to the ground.

— Create a common ground for the equipment you are working on by connecting the static-free mat, static strap, and peripheral units to that piece of equipment.

NOTE: HP accessories are for use in HP products. They have been extensively tested for reliability and are manufactured to high quality standards.

Service considerations

Tools and software requirements

The tools necessary for computer component removal and installation are:

- Torx T-15 driver
- Flat blade and cross-tip screwdrivers
- Diagnostics software

Electrostatic discharge (ESD) information

Generating static

Different activities generate different amounts of static electricity through electrostatic discharge (ESD). Static electricity increases as humidity decreases.

CAUTION: Static electricity in the amount of 700 volts might degrade a product.

Event	Relative humidity		
	55%	40%	10%
Walking across carpet	7,500V	15,000V	35,000V
Walking across vinyl floor	3,000V	5,000V	12,000V
Motions of bench worker	400V	800V	6,000V
Removing bubble pack from PCB	7,000V	20,000V	26,500V
Packing PCBs in foam-lined box	5,000V	11,000V	21,000V

Preventing ESD equipment damage

Many electronic components are sensitive to ESD. Circuitry design and structure determine the degree of sensitivity. The following packaging and grounding precautions are necessary to prevent damage to electric components and accessories:

- Transport products in static-safe containers such as tubes, bags, or boxes, to avoid hand contact.
- Protect electrostatic parts and assemblies with nonconductive or approved containers or packaging.
- Keep electrostatic-sensitive parts in their containers until they arrive at static-free stations.
- Place items on a grounded surface before removing them from containers.
- When handling or touching a sensitive component or assembly, ground yourself by touching the chassis.
- Avoid contact with pins, leads, or circuitry.
- Place reusable electrostatic-sensitive parts from assemblies in protective packaging or nonconductive foam.

<table>
<tr><td>Personal grounding methods and equipment</td><td colspan="2">Use the following items to help prevent ESD damage:
Wrist straps — These are flexible straps with a maximum of one megohm ± 10% resistance in the ground cords. To provide a proper ground, wear the strap against bare skin. The ground cord must be connected and fit snugly into the banana plug connector on the grounding mat or computer.
Heel straps, toe straps, and boot straps — These can be used at standing computers and are compatible with most types of shoes or boots. On conductive floors or dissipative floor mats, use them on both feet with a maximum of one megohm ± 10% resistance between the operator and ground.</td></tr>
<tr><td>Static shielding materials</td><td colspan="2">Static shielding materials provide the following levels of protection.<table><tr><th>Method</th><th>Voltage</th></tr><tr><td>Antistatic plastic</td><td>1,500V</td></tr><tr><td>Carbon-loaded plastic</td><td>7,500V</td></tr><tr><td>Metalized laminate</td><td>15,000V</td></tr></table></td></tr>
<tr><td>Grounding the work area to prevent static damage</td><td>Cover the work surface with approved static-dissipative material. Use a wrist strap connected to the work surface, and properly grounded tools and equipment.
Use static-dissipative mats, foot straps, or air ionizers to give added protection.
Handle electrostatic-sensitive components, parts, and assemblies by the case or PCB laminate. Handle them only in static-free work areas.</td><td>Disconnect power and input signals before inserting and removing connectors or test equipment.
Use fixtures made of static-safe materials when fixtures must directly contact dissipative surfaces.
Keep work area free of nonconductive materials, such as plastic assembly aids and Styrofoam.
Use field service tools (such as cutters, screwdrivers, and vacuums) that are conductive.</td></tr>
<tr><td>Recommended ESD prevention materials and equipment</td><td>Antistatic tape
Antistatic smocks, aprons, and sleeve protectors
Conductive bins and other assembly or soldering aids
Conductive foam
Conductive tabletop computers with a ground cord of one megohm ± 10% resistance
Static-dissipative table or floor mats with a hard-tie to ground
Field service kits</td><td>Static awareness labels
Wrist straps and footwear straps providing one megohm ± 10% resistance
Material-handling packages
Conductive plastic bags
Conductive plastic tubes
Conductive tote boxes
Opaque shielding bags
Transparent metallized shielding bags
Transparent shielding tubes</td></tr>
</table>

Product recycling

HP encourages customers to recycle used electronic hardware, HP original print cartridges, and rechargeable batteries.

For information about recycling HP components or products, see http://www.hp.com/go/recycle.

Component replacement guidelines

This section provides information and guidelines for removal and replacement procedures. It does not document the step-by-step procedures.

IMPORTANT: Removal and replacement procedures are now available in videos on the HP website.

Go to the HP Customer Self Repair Services Media Library at http://www.hp.com/go/sml.

For workstation removal and replacement procedures, go to the HP Customer Self Repair Services Media Library at http://www.hp.com/go/sml. In Media Selection, choose **Desktops & Workstations** for product category and **Personal Workstations** for the product family, and then choose your platform.

This chapter provides guidelines for removal and replacement procedures. Topics include:

Battery on page 45

Cable management on page 46

CPU (processor) and CPU heatsink on page 47

Expansion slots on page 47

Hard drives on page 48

Memory on page 49

Power supply on page 51

Thermal sensors on page 53

Battery

The battery that comes with the computer provides power to the real-time clock and has a minimum lifetime of about three years. Observe the following warning and caution when replacing the battery.

WARNING! The workstation has a lithium battery. There is a risk of fire and chemical burn if the battery is handled improperly. Do not disassemble, crush, puncture, short external contacts, dispose of in water or fire, or expose battery to temperatures higher than 60°C (140°F).

CAUTION: Before removing the battery, back up the CMOS settings in case they are lost when the battery is removed. To back up the CMOS settings, select the **Save to Removable Storage** option in Computer Setup (F10) Utility.

NOTE: Do not dispose of batteries, battery packs, and accumulators with general household waste.

Cable management

Proper routing of the internal cables is critical to the operation of the workstation. Follow good cable management practices when removing and installing components.

- Handle cables with care to avoid damage.
- Apply only the tension required to seat or unseat cables during insertion or removal from the connector.
- When possible, handle cables by the connector or pull-strap.
- Route cables in such a way that they cannot be caught or snagged by parts being removed or replaced.
- Keep cables away from direct contact with major heat sources, such as the heatsink. (Some air flow guides have a cable guide that lets you route cables safely around the heatsink.)
- Do not jam cables on top of expansion cards or DIMMs. Circuit cards and DIMMs are not designed to take excessive pressure.
- Keep cables clear of movable or rotating parts (such as the power supply and drive cage) to prevent them from being cut or crimped when the component is lowered into its normal position.
- When folding a flat ribbon cable, never fold to a sharp crease. Sharp creases may damage the wires.
- In all cases, avoid bending or twisting the cables. Do not bend any cable sharply. A sharp bend can break the internal wires.
- Never bend a SATA data cable tighter than a 30 mm (1.18 in) radius.
- Never crease a SATA data cable.
- Do not rely on components like the drive cage, power supply, or computer cover to push cables down into the chassis. Always position the cables to lay properly by themselves or in the cable guides and chassis areas designed for cable routing.

When removing the power supply power cable from the connector on the system board, always follow these steps:

1. Squeeze on the top of the retaining latch attached to the cable end of the connector.
2. Grasp the cable end of the connector and pull it straight out.

⚠ **CAUTION:** Always pull the connector — NEVER pull on the cable. Pulling on the cable could damage the cable and result in a failed power supply.

CPU (processor) and CPU heatsink

CAUTION: Observe the following cautions when removing or replacing the heatsink.

— When removing the heatsink, loosen all screws a little at a time to ensure the CPU remains level. Do *not* fully loosen one screw, and then move on to the next.

— Do not overtighten the heatsink screws. Overtightening can strip the threads in the chassis.

CAUTION: Observe the following cautions when removing or replacing the CPU.

— Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove or install a component.

— Do not touch the CPU socket contacts or the gold pads underneath the CPU. Use extreme care and handle the CPU only by the edges.

— The CPU socket contacts are delicate and bend easily. To avoid bending the contacts, use extreme care when installing the CPU in the socket.

— Installing a processor incorrectly can damage the system board. Contact an HP authorized reseller or service provider to install the processor. If you plan to install the processor yourself, view the entire remove and replace video before you begin.

— Failure to follow the computer preparation instructions can result in an improperly installed processor, causing extensive computer damage.

NOTE: When you power off the computer through the operating system, power consumption falls below what is considered low power consumption but does not reach zero. This low power consumption feature extends the life of the power supply.

Expansion slots

The workstation has the following expansion slots:

- One MXM slot that supports Type A and Type B cards (dedicated for graphics)
- Three Mini PCIe slots that support full-length mini-PCIe cards

Go to http://www.hp.com/go/quickspecs to learn which cards are supported in the workstation.

CAUTION: To prevent damage, the overall power consumption of the computer (including I/O cards, CPU, and memory) must not exceed the maximum rating of the computer power supply. For power supply information, see Power supply specifications on page 51.

Hard drives

- To verify the type, size, and capacity of the storage devices installed in the computer, run **Computer Setup (F10) Utility**.
- The workstation supports only SATA hard drives.
- The workstation requires one of the following supported carriers:
  - 671193-001 supports one 3.5-in hard drive
  - 671192-001 supports one or two 2.5-in hard drives
- Combining a 2.5-in hard drive and 3.5-in hard drive is not possible.
- No cable adapters are required for any hard drives. The cables necessary for all hard drive configurations are included in the base system and automatically “blind mate” or “direct connect” to the drive(s) when installed.

Handling hard disk drives

⚠ **CAUTION:** Take proper precautions when handling hard disk drives to prevent loss of work and damage to the computer or drive.

- Do not remove hard drives from the shipping package for storage. Keep hard drives in their protective packaging until they are mounted in the computer.
- Always shut down the operating system, turn off the power, and unplug the power cord. Never remove a drive while the computer is on or in standby mode.
- Before handling a drive, make sure you discharge static electricity. While handling a drive, avoid touching the connector.
- Handle a drive carefully. Do not drop it from any height.
- Do not use excessive force when inserting a drive.
- Avoid exposing a hard drive to liquids, temperature extremes, or products that have magnetic fields such as monitors or speakers.
- If you must mail a drive, use a bubble-pack mailer or other protective packaging and label the package “Fragile: Handle With Care.”

Memory

Supported DIMM configurations

The HP Z1 Workstation has 4 DIMM slots and supports up to 32 GB ECC or 8 GB non-ECC unbuffered DDR3 1600 MHz memory.

NOTE: Mirroring and DIMM sparing are not supported.

- Four DIMM slots
- Maximum capacity: 32 GB
- Error checking and correcting (ECC) and non-ECC DIMMs only.

BIOS errors and warnings

The BIOS generates warnings/errors on invalid memory configurations:

- If the BIOS can find a valid memory configuration by disabling plugged-in memory, it does so and reports a warning during POST. the workstation can still be started. The warning will indicate the location of the failed DIMM on the system board.
- If there is no way for the BIOS to obtain a valid memory configuration by disabling plugged-in memory, the BIOS halts with a diagnostics 2006 code for memory error (five beeps and blinks).

DIMM installation guidelines

- Install only HP-approved DDR3 DIMMs

CAUTION: HP ships only DIMMs that are electrically and thermally compatible with this computer. Because third-party DIMMs might not be electrically or thermally compatible, they are not supported by HP.

- For ECC DIMMs, use only industry-standard ECC unbuffered DIMMs. See http://www.hp.com/go/quickspecs to find which DIMMs are compatible with the computer.
- Do not intermix non-ECC memory DIMMs with ECC memory DIMMs.

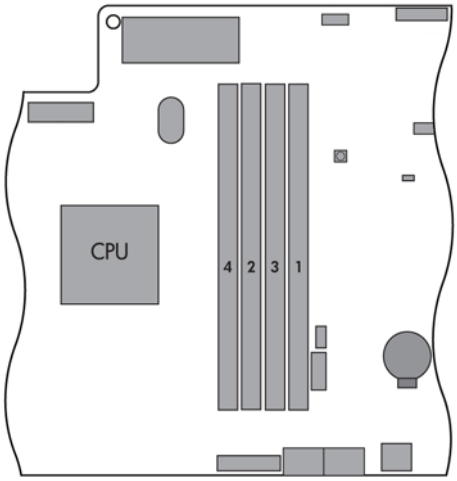
CAUTION: DIMMs and their sockets are keyed for proper installation. To prevent socket or DIMM damage, align these guides properly when installing DIMMs.

DIMM installation order

Install DIMMs in this order.

⚠ **CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove or install a component.

Figure 3-1 HP Z1 Workstation DIMM load order



Power supply

The workstation includes a 400W 90% efficient 80 PLUS gold-level power supply that is compatible with ENERGY STAR requirements.

Power supply specifications

Table 3-1 Power supply specifications

Power supply	400W wide-ranging, active Power Factor Correction, 90% efficient
Operating voltage range	90–264 VAC
Rated voltage range	100–240 VAC
Rated line frequency	50–60 Hz
Operating line frequency range	47–63 Hz
Rated input current	5A @ 100-240V
Heat dissipation, typical (configuration and software dependent)	170 BTU/hr (42.87 kg-cal/hr) 1063 BTU/hr (206.27 kg-cal/hr)
Heat dissipation, maximum (configuration and software dependent)	1063 btu/hr (TBD kg-cal/hr)
Power supply fan *All fans are variable speed*	Two variable speed fans, 40mm x 20mm
Built-in Self Test LED	Yes
Power Consumption in sleep mode (as defined by ENERGY STAR) - Suspend to RAM (S3)	<4W
ENERGY STAR® qualified (Config Dependent)	Yes
80 PLUS Compliant	Yes, Gold
FEMP Standby Power Compliant	Yes, <2W in S5-Power Off @ 115VAC
Surge tolerant, full-ranging (withstands power surges up to 2000V)	Yes
ErP Lot 6- Tier 1 compliance @ 230V (<1W in S5- power Off)	Yes
ErP Lot 6- Tier 2 compliance @ 230V (<0.5W in S5- power Off)	Yes

Power consumption and heat dissipation

Power consumption and heat dissipation specifications are available for multiple configurations. To review available specifications, see http://www.hp.com/go/quickspecs.

To reach zero power consumption, unplug the workstation from the power outlet or use a power strip with an on/off switch. For additional information about power-saving features, see the operating system installation instructions.

This product is in compliance with U.S. Executive Order 13221 (FEMP).

Resetting the power supply

If an overload triggers the power supply overload protection, power is immediately disconnected.

To reset the power supply:

1. Disconnect the power cord from the workstation.
2. Determine what caused the overload and fix the problem. For troubleshooting information, see Diagnostics and troubleshooting on page 54.
3. Reconnect the power cord and restart the workstation.

When you power off the workstation through the operating system, power consumption falls below what is considered low power consumption but does not reach zero. This low power consumption feature extends the life of the power supply.

Thermal sensors

The following illustration shows the locations of the thermal sensors. Sensors that attach with a harness can be replaced.

Figure 3-2 Thermal sensor locations

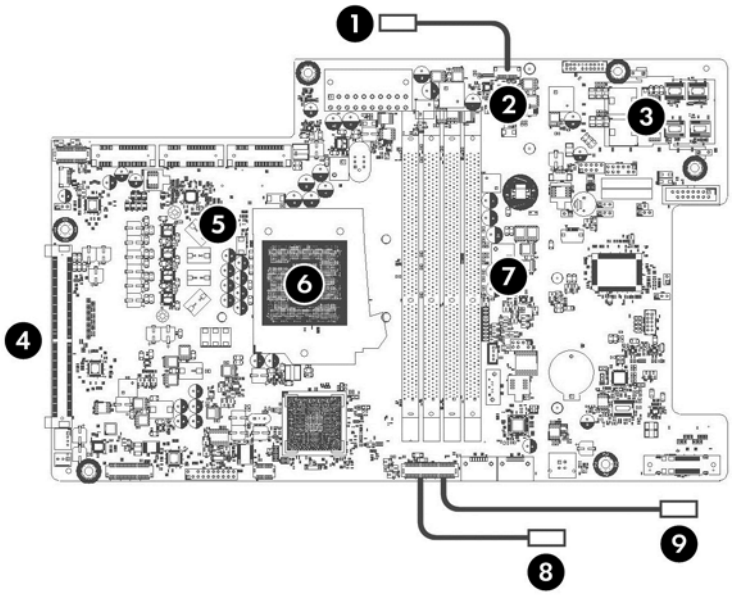


Table 3-2 Thermal sensor descriptions

1	Outlet air sensor	**4**	MXM GPU sensor	**7**	Memory VR sensor
2	12V-3.3V VR sensor	**5**	CPU0 VR sensor	**8**	Hard disk drive sensor
3	Backlight VR sensor	**6**	CPU0 DTS sensor (inside processor)	**9**	Inlet air sensor

4 Diagnostics and troubleshooting

This chapter describes the tools available for diagnosing and troubleshooting system issues, and includes these topics:

Topics
Calling support on page 55
Locating ID labels on page 56
Locating warranty information on page 56
Diagnosis guidelines on page 57
Troubleshooting checklist on page 58
HP troubleshooting resources and tools on page 59
Troubleshooting scenarios and solutions on page 63
Self-troubleshooting with HP Vision Diagnostics on page 74
Diagnostic codes and errors on page 83

Calling support

At times you might encounter an issue that requires support. When you call support:

- Have the computer readily accessible.
- Write down the computer serial numbers, product numbers, model names, and model numbers and have them in front of you.
- Note any applicable error messages.
- Note any add-on options.
- Note the operating system.
- Note any third-party hardware or software.
- Note the details of any blinking LEDs on the front of the computer (tower and desktop configurations) or on the side of the computer (all-in-one configurations).
- Note the applications you were using when you encountered the problem.

NOTE: When calling in for service or support, you might be asked for the product number (example: PS988AV) of the computer. If the computer has a product number, it is generally located next to the 10- or 12-digit serial number of the computer.

NOTE: On most models, the serial number and product number labels can be found on the top or side panel and at the rear of the computer (tower and desktop configurations) or on a pull-out card on the side of the display (all-in-one configurations).

For a listing of all worldwide support phone numbers, go to http://www.hp.com/support, select your region, and click **Connect with HP** in the upper-right corner.

Locating ID labels

To assist in troubleshooting, product, serial, and authentication numbers are available on each computer.

- All workstations have a serial number (unique for each workstation) and product number. Have these numbers available when you contact support.
- The Certificate of Authentication (COA) is used only for systems with Windows 7 preinstalled.
- The Genuine Microsoft Label (GML) is used only for systems with Windows 8 preinstalled.
- A service label shows the build ID and Feature Byte strings, which are needed for system board replacement.

The all-in-one service label can be found in the location shown in Figure 4-1 (pull-out card).

Figure 4-1 All-in-one service label location

Locating warranty information

To locate base warranty information, see http://www.hp.com/support/warranty-lookuptool.

To locate an existing Care Pack, see http://www.hp.com/go/lookuptool.

To extend a standard product warranty, visit http://www.hp.com/hps/carepack. HP Care Pack Services offer upgraded service levels to extend and expand a standard product warranty.

Diagnosis guidelines

If you encounter a problem with the computer or software, the following sections provide a list of general suggestions that help you isolate and focus on the problem before taking further action.

Diagnosis at startup

- Verify that the computer and external monitor (if connected) are plugged into a functional AC power outlet.
- Remove all CDs or USB drive keys from your system before turning it on.
- Verify that the computer is turned on and the power light is blue (normal operation) and not red (error state).
- If you have installed an operating system other than the factory-installed operating system, check to be sure that it is supported on your system by visiting http://www.hp.com/go/quickspecs.

Diagnosis during operation

- Look for blinking LEDs on the side of the computer. The blinking lights are error codes that will help you diagnose the problem. Refer to the Diagnostic LED and audible (beep) codes on page 83 section of this document for information on interpreting diagnostic lights and audible codes.
- Check all cables for loose or incorrect connections.
- Wake the computer by pressing any key on the keyboard or the power button. If the system remains in suspend mode, shut down the system by pressing and holding the power button for at least four seconds, and then press the power button again to restart the system. If the system does not shut down, unplug the power cord, wait a few seconds, and then plug it in again. If it does not restart, press the power button to start the computer.
- Reconfigure the computer after installing a non–plug and play expansion board or other option.
- Be sure that all required device drivers have been installed. For example, if you have connected a printer, you must install a printer driver.
- If you are working on a network, plug another computer with a different cable into the network connection. There might be a problem with the network plug or cable.
- If you recently added new hardware, remove it and see if the computer functions properly.
- If you recently installed new software, uninstall it and see if the computer functions properly.
- Upgrade the BIOS. A new release of the BIOS might have been released that supports new features or fixes your problem.
- Press the Caps Lock key. If the Caps Lock LED toggles on or off, the keyboard is operating correctly.

Troubleshooting checklist

Before running diagnostic utilities, use the following checklist to find possible solutions for computer or software problems.

- Is the computer connected to a functional AC power outlet?
- Is the computer powered on?
- Is the blue power light illuminated?
- If the internal display is dim, adjust the internal display brightness and contrast controls.
- Press the Caps Lock key several times. If the Caps Lock LED toggles on and off, the keyboard is operating correctly.
- Check cables for loose or improper connections.
- After installing a non-plug and play (PnP) expansion board or other option (such as a diskette drive), reconfigure the computer.
- Are all necessary device drivers installed?
- Have all printer drivers been installed for each application?
- Have you removed CDs and USB drive keys before powering on the computer?
- Are you running the latest version of BIOS, drivers, and software?

HP troubleshooting resources and tools

This section provides information on the HP Help and Support Center, E-support, and Helpful Hints for troubleshooting.

HP Support Assistant

HP Support Assistant (Windows 7 systems only) helps you maintain workstation performance and resolve problems. HPSA provides automated updates, onboard diagnostics, product information, and guided assistance to help maintain optimum workstation performance. To access HPSA, click **Start > All Programs > HP Help and Support > HP Support Assistant**.

NOTE: HP Support Assistant is not available on Linux.

E-support

Online access and support resources include Web-based troubleshooting tools, technical knowledge databases, driver and patch downloads, online communities, and product change notification services.

The following Web sites are also available to you:

- http://www.hp.com—Provides useful product information.
- http://www.hp.com/support/workstation_manuals—Provides the latest online documentation.
- http://www.hp.com/go/workstationsupport—Provides technical support information for workstations.
- http://www.hp.com/support—Provides a listing of the worldwide technical support phone numbers. Access the telephone numbers by visiting the Web site, then select your region, and click **Contact HP** in the upper-left corner.
- http://www.hp.com/support/workstation_swdrivers—Provides access to software and drivers for workstations.

Troubleshooting a problem

To help you troubleshoot problems with your system, HP provides the Business Support Center (BSC). The BSC is a portal to an extensive selection of online tools. To access BSC and troubleshoot a problem with the workstation, complete the following:

1. Visit http://www.hp.com/go/workstationsupport.
2. Under the **Business Support Center** menu on the left, select **Troubleshoot a problem**.
3. Under **Select your product** (center window), select **Workstations** (under **personal computing**).
4. Under **Select your product**, continue with selections as appropriate to the workstation series and model, and to the problem you are troubleshooting.

Instant Support and Active Chat

HP Instant Support is a set of Web-based support tools that automate and speed up the resolution of desktop computing, tape storage, and printing problems.

Active Chat enables you to electronically submit a support ticket to HP over the Web. When you submit a support ticket, Active Chat collects information about the computer and pass it to an online support specialist. The collection of information might take up to 30 seconds depending on the computer configuration. When you submit a support ticket, you receive a confirmation message containing your case ID, the support hours for your location, and the estimated time of response.

For more information about HP Instant Support and Active Chat and how to use them, go to http://instantsupport.hp.com/.

NOTE: This feature is not available on Linux.

Customer Advisories, Customer and Security Bulletins, and Customer Notices

To find advisories, bulletins, and notices:

1. Visit http://www.hp.com/go/workstationsupport.
2. Select the desired product.
3. Under **Resources for <your selected product>**, select **See more...**.
4. Under **Self-Help resources:** in the center of the window, choose the desired action and appropriate information in the scroll list to view the index.

Product Change Notifications

Product Change Notifications (PCNs) are proactive notifications for product changes occurring within a 30-60 day window of the effective date of the change in the manufacturing process. PCNs give customers advanced notice of changes to their product, such as an updated BIOS version that they may need to qualify prior to the change taking place. The latest PCNs are located at: http://www.hp.com/go/workstationsupport.

Helpful hints

If you encounter a problem with the workstation, monitor, or software, the following general suggestions might help you isolate and focus on the problem before taking further action.

At startup

- Verify that the workstation and monitor are plugged into a working electrical outlet.
- Remove all optical discs and USB drive keys from the drives before powering on the workstation.
- Verify that the workstation is turned on and the power light is on.
- If you have installed an operating system other than the factory-installed operating system, check to be sure that it is supported on your system by visiting http://www.hp.com/go/quickspecs.
- Verify that the monitor is turned on and the green monitor light is on.
- Turn up the brightness and contrast controls of the monitor if the monitor is dim.
- If the workstation has multiple video sources and only a single monitor, the monitor must be connected to the source selected as the primary VGA adapter. During startup, the other monitor connectors are disabled; if the monitor is connected to one of these ports, it will not function after Power-on Self Test (POST). You can select the default VGA source in Computer Setup (F10).

During operation

- Look for blinking LEDs on the workstation. The blinking lights are error codes that will help you diagnose the problem. Refer to the *Diagnostic lights and audible (beep) codes* section in the *Maintenance and Service Guide* for your workstation for information on interpreting diagnostic lights and audible codes.
- Press and hold any key. If the system beeps, then your keyboard is operating correctly.
- Check all cables for loose or incorrect connections.
- Wake the workstation by pressing any key on the keyboard or the power button. If the system remains in suspend mode, shut down the system by pressing and holding the power button for at least four seconds, then press the power button again to restart the system. If the system does not shut down, unplug the power cord, wait a few seconds, then plug it in again. If it does not restart, press the power button to start the workstation.
- Reconfigure the workstation after installing a non–plug and play expansion board or other option. Refer to the *Hardware installation problems* section of this document for instructions.
- Be sure that all required device drivers have been installed. For example, if you have connected a printer, you must install a printer driver.
- If you are working on a network, plug another workstation with a different cable into the network connection. There might be a problem with the network plug or cable.
- If you recently added new hardware, remove the hardware and verify if the workstation functions properly.
- If you recently installed new software, uninstall the software and verify if the workstation functions properly.

- If the monitor connected to a tower, desktop or all-in-one computer is blank:
  - Plug the monitor into a different video port on the computer if one is available. Alternatively, replace the monitor with a monitor that you know is working properly.
  - Verify that the computer *and monitor* are plugged into a working electrical outlet.
  - Verify that the monitor is turned on and the green monitor light is on.
  - Turn up the brightness and contrast controls of the monitor if the monitor is dim.
- If the internal display on an all-in-one computer is blank, open the computer and make sure the graphics card is properly installed.
- Upgrade the BIOS. A new release of the BIOS might have been released that supports new features or fixes your problem.

Customer self-repair

Under the Customer Self-Repair program, you can order a replacement part and install the part without onsite HP technical assistance. Customer self-repair may be required for some components. See http://www.hp.com/go/selfrepair for information on the program.

NOTE: Some components are not eligible for customer self-repair and must be returned to HP for service. Call HP Support for further instructions before attempting to remove or repair these components.

Troubleshooting scenarios and solutions

This section presents an extensive overview of various troubleshooting scenarios and possible solutions for a Windows-based computer.

NOTE: For Linux troubleshooting information, refer to the *HP Workstations for Linux User Manual* at http://www.hp.com/support/linux_user_manual.

Solving minor problems

Table 4-1 Minor problems

Problem	Cause	Possible Solution
Workstation appears frozen and does not shut down when the power button is pressed.	Software control of the power switch is not functional.	1. Press and hold the power button for at least four seconds until the computer shuts down. 2. Disconnect the electrical plug from the outlet.
Workstation seems to be frozen.	Program in use has stopped responding to commands.	1. If possible, use the Windows Task Manager to isolate and terminate the offending process. 2. Attempt the normal Windows shutdown procedure. 3. Restart the computer using the power button.
Workstation date and time display is incorrect.	Real-time clock (RTC) battery might need replacement.	1. Reset the date and time in the Control Panel. 2. Replace the RTC battery.
Workstation appears to pause periodically.	Network driver is loaded and no network connection is established.	Establish a network connection, or use Computer Setup (F10) Utility or the Microsoft® Windows® Device Manager to disable the network controller.
Cursor does not move using the arrow keys on the keypad.	The Num Lock key might be on.	Press Num Lock. The Num Lock key can be disabled or enabled in Computer Setup (F10) Utility.
Poor performance is experienced.	Processor is hot.	1. Verify that airflow to the computer is not blocked. 2. Verify that chassis fans are connected and working properly. Some fans operate only when needed. 3. Verify that the processor heatsink is installed properly.
	Hard drive is full.	Transfer data from the hard drive to create more space on the hard drive.

Table 4-1 Minor problems (continued)

Problem	Cause	Possible Solution
Workstation powered off automatically and the Power LED flashes red two times (once per second), followed by a two second pause, and then two consecutive beeps.	Processor thermal protection is activated. A fan might be blocked or not turning. OR The processor heatsink is not properly attached to the processor.	1. Verify that the computer air vents are not blocked. 2. Open the access panel and press the computer power button. 3. Verify that the system fan is running. 4. Verify that the processor heatsink fan spins. If the fan is not spinning, verify that the heatsink fan cable is plugged into the system board connector and that the heatsink is properly seated. 5. Replace the processor heatsink.
System does not power on, and the LEDs on the side of the computer are not flashing.	System cannot power on.	Press and hold the power button for less than four seconds. If the hard drive LED turns green, then perform the following steps. 1. To find a faulty device, remove all devices one at a time: a. Disconnect AC power to the computer. b. Remove a device. c. Reconnect AC power and power on the computer. 2. Repeat this process until the faulty device is identified. Remove the graphics card last. Replace the faulty device. 3. If no faulty device is found, replace the system board. OR 1. Press and hold the power button for *less than* four seconds. If the hard drive LED does not illuminate, then perform the following tasks: a. Verify that the computer is plugged into a working AC outlet. b. Verify that the power button harness is connected to the inline front panel I/O device assembly connector. 2. Verify that the power supply cables are connected to the system board.

Solving hard drive problems

Table 4-2 Hard drive problems

Problem	Cause	Solution
Hard drive error occurs.	Hard disk has bad sectors or has failed.	Locate and block the usage of bad sectors. If necessary, reformat the hard disk. If the drive is detected by the UEFI, run DPS Self-test.
Hard drive transaction problem.	The directory structure is bad, or there is a problem with a file.	1. Right-click **Start**, select **Explore**, and select a drive. 2. Select **File > Properties > Tools**. 3. Under Error-checking, select **Check Now**.
Drive not found (identified).	Improper cable connection	On computers with discreet data and power cables, ensure that the data and power cables are securely connected to the hard drive. (See the *Hard drive* section of this guide for connection details.)
	Improperly seated hard drive	On systems with blind-mate drive connections, check for connector damage on the drive and in the chassis. Reseat the hard drive and its carrier in the chassis to ensure a proper connection. (See the *Hard drive* section of this guide for connection details.)
	The system might not have automatically recognized a newly installed device.	1. Run Computer Setup (F10) Utility. 2. If the system does not recognize the new device, verify that the device is listed in the Computer Setup (F10) Utility. If it is listed, the probable cause is a driver problem. If it is not listed, the probable cause is a hardware problem. 3. If this drive is newly installed, enter **Setup** and try adding a POST delay under Advanced>Power-On.
	Drive responds slowly immediately after power-up.	Run the Computer Setup (F10) utility, and increase the POST Delay in Advanced>Power-On Options.

Table 4-2 Hard drive problems (continued)

Problem	Cause	Solution
Nonsystem disk or NTLDR missing message.	System is trying to start from non-bootable media.	Remove the media device.
	System is trying to start from a damaged hard drive.	1. Insert bootable media and restart the computer. 2. If the hard drive is still inaccessible and MBR Security is enabled, try restoring the previously saved MBR image by entering the Computer Setup (F10) Utility and selecting **Security > Restore Master Boot Record**.
	System files missing or not properly installed.	1. Insert bootable media and restart the computer. 2. Verify that the hard drive is partitioned and formatted. 3. Install the system files for the appropriate operating system, if necessary.
	Hard drive boot disabled in Computer Setup.	Run the Computer Setup (F10) Utility and enable the hard drive entry in the Storage>Boot Order list.
Workstation will not start.	Hard drive is damaged.	Replace the hard drive.

Solving display problems

Table 4-3 Internal LCD display problems

Problem	Cause	Solution
Blank screen (no video).	Cable connections are not correct.	1. Verify the LCD display cable connection to J16 on the system board and to the internal LCD panel connector. 2. Verify the LCD sync/backlight cable connection to P2 on the system board and to the sync connector and the LED power connector on the internal LCD panel.
	Screen blanking utility installed or energy saver features enabled.	Press a key or the mouse button and, if set, enter your password.
	System ROM is bad; system is running in FailSafe Boot Block mode (indicated by 8 beeps).	Reflash the ROM using a SoftPaq.
	Backlight circuit on motherboard is damaged.	Replace the motherboard.
	Computer is in Hibernate mode.	Press the power button to resume from Hibernate mode.

Table 4-3 Internal LCD display problems (continued)

Problem	Cause	Solution
	The key sequence that switches the DisplayPort connector from internal graphics source to external graphics source was pressed, but there is no external source (such as a laptop) for graphics.	On the workstation keyboard: 1. Simultaneously press Ctrl + Shift + S+D (*switch display*). This reverts the workstation to internal graphics source and places the workstation display in standby mode. 2. Press the space bar (or move the mouse) to wake up the display.
The display works properly during the POST but goes blank when the operating system starts.	The display settings in the operating system are incompatible with the internal LCD panel.	For Windows: 1. Restart your computer in Windows Safe Mode. 2. Uninstall the graphics driver for the graphics controller (Intel HD Graphics or NVIDIA Graphics). 3. Reboot in normal Windows mode. 4. Install the latest graphics driver for the graphics controller you are using (Intel HD Graphics or NVIDIA Graphics).
Power LED flashes red 6 times (once every second), followed by a 2-second pause, then the computer beeps 6 times.	Previdео graphics error.	Try these solutions in this order: • Reseat the graphics card if using nVidia graphics; reseat the processor if using Intel HD Graphics. • Replace the graphics card if using nVidia graphics or replace the processor if using Intel HD graphics. • Replace the system board.
	Processor does not support graphics output and no discrete graphics card is installed.	Try either solution: • Install a processor with Intel HD Graphics. • Install a supported graphics card.
Dim characters	Brightness and contrast controls are not set properly.	In Windows, go to **Control Panel > Power Options**, then adjust the internal LCD panel brightness and contrast controls using the **Screen Brightness** slider bar at the bottom of the window.
	Cables are not properly connected.	1. Open the computer. 2. Verify that the LCD Display Cable connects J16 on the system board to the internal LCD panel connector. 3. Verify that the LCD Sync/backlight Cable connects P2 on the system board to the sync connector and LED power connector on the internal LCD panel.

Table 4-3 Internal LCD display problems (continued)

Problem	Cause	Solution
Blurry video or requested resolution cannot be set.	Correct video drivers were not loaded after graphics controller upgrade.	Install the video drivers included in the upgrade kit, or download and install the latest drivers for your graphics card from http://welcome.hp.com/country/us/en/support.html.
	The internal LCD panel cannot display requested resolution.	1. Change the resolution to either 2560 x 1440 or 1280 x 720. 2. Update the graphics driver to the latest version available for your graphics controller.
	The graphics driver is not working properly.	1. Boot into the OS and uninstall the graphics driver. 2. Restart the computer. 3. Install the latest graphics driver for your graphics controller.
The picture is broken up, rolls, jitters, or flashes.	The internal LCD panel connections to the motherboard might be faulty or the panel might be incorrectly adjusted.	Open the computer. 1. Verify the LCD display cable connects J16 on the system board to the display connector on the internal LCD panel. 2. Verify that the LCD Ssync/backlight cable connects P2 on the system board to the sync connector and LED power connector on the internal LCD panel.
	The graphics driver is not working properly.	1. Boot into the OS and uninstall the graphics driver. 2. Reboot. 3. Install the latest graphics driver for your graphics controller.
Some typed symbols do not appear correctly.	The font you are using does not support that symbol.	Use the Character Map to locate and select the appropriate symbol. Select **Start > All Programs > Accessories > System Tools > Character Map**. You can copy the symbol from the Character Map into a document.
	The LCD panel resolution is not properly set.	Change the panel resolution in the Windows **Control Panel > Screen Resolution** menu or through the control panel for the graphics controller (Intel or nVidia).
	The graphics driver does is not working properly or does not support the symbol set with that resolution.	Try either solution: • Change the panel resolution in the Windows **Control Panel > Screen Resolution** menu or through the control panel for the graphics controller (Intel or nVidia). • Install the latest graphics driver: 1. Boot into the OS and uninstall the graphics driver. 2. Restart the computer. 3. Install the latest graphics driver for your graphics controller.

Table 4-4 External display problems

Problem	Cause	Solution
Blank screen (no video).	The cable connections are not correct.	Verify the cable connections from the monitor to the computer and to a working electrical outlet.
	The monitor is off.	Turn the monitor on (LED is on). You might need to refer to the monitor manual for an explanation of LED signals.
	Screen blanking utility installed or energy saver features enabled.	Press a key or the mouse button and, if set, enter your password.
	System ROM is bad; system is running in FailSafe Boot Block mode (indicated by 8 beeps).	Reflash the ROM using a SoftPaq.
	Processor does not support graphics output and no discrete graphics card is installed. NOTE: Power LED flashes red 6 times (once every second), followed by a 2-second pause, followed by 6 beeps.	Either: • Install a processor with graphics support. • Install a supported MXM graphics card.
	Computer is in Hibernate mode.	Press the power button to resume from Hibernate mode.
	Multiple displays are not enabled in the graphics control panel.	Go to the graphics control panel and enable multi-display by selecting either clone mode or extended mode.
	The graphics driver is not loaded.	Install the latest graphics driver.
	The graphics driver is not working properly.	1. When you see **Press F8** in the bottom-right corner of the screen, restart the computer and press F8 during startup. 2. Using the keyboard arrow keys, select **Windows Safe Mode**, then press Enter. 3. In Windows, uninstall the graphics driver. 4. Reboot the computer into the normal Windows mode. 5. Install the latest graphics driver.
The display works properly during the POST but goes blank when the operating system starts.	The display settings in the operating system are incompatible with your graphics card and monitor.	1. For Windows, restart your computer in Windows Safe Mode. 2. After the operating system starts, change the display settings to match those supported by your graphics card and monitor. 3. Refer to your operating system and graphics card documentation for information about changing display settings.
	Multiple displays are not enabled in the graphics control panel.	Go to the graphics control panel and enable multi-display by selecting either clone mode or extended mode.
	The graphics driver is not loaded.	Install the latest graphics driver.

Table 4-4 External display problems (continued)

Problem	Cause	Solution
Power LED flashes red 6 times (once every second), followed by a 2-second pause, followed by 6 beeps.	Prevideo graphics error.	Try these solutions in this order: • Reseat the graphics card if using nVidia graphics; reseat the processor if using Intel HD Graphics. • Replace the graphics card if using nVidia graphics or replace the processor if using Intel HD graphics. • Replace the system board.
	Processor does not support graphics output and no discrete graphics card is installed.	Either: • Install a processor with Intel HD Graphics. • Install a supported graphics card.
Dim characters	The brightness and contrast controls are not set properly.	Adjust the monitor brightness and contrast controls.
	Cables are not properly connected.	1. Verify that the monitor cable is securely connected to the computer and the monitor. 2. Verify that internal Rear IO DP/LAN cable is connected to the system board and the Rear I/O board: a. Open the computer. b. Verify the Rear IO DP/LAN Cable is connected to CON6701 on the system board and J16 on the Rear I/O board (on the left bottom side).
Blurry video or requested resolution cannot be set.	If the graphics controller was upgraded, the correct video drivers might not be loaded.	Install the video drivers included in the upgrade kit, or download and install the latest drivers for your graphics card from http://welcome.hp.com/country/us/en/support.html.
	Monitor cannot display requested resolution.	Change the resolution.
The picture is broken up, rolls, jitters, or flashes.	The monitor connections might be faulty, or the monitor might be incorrectly adjusted.	1. Verify that the monitor cable is securely connected to the computer and the monitor. 2. Verify that internal rear IO DP/LAN cable is connected to the system board and the rear I/O board: a. Open the computer. b. Verify the rear IO DP/LAN cable is connected to CON6701 on the system board and J16 on the rear I/O board (on the left bottom side).
	Monitor must be degaussed.	Degauss the monitor.
High pitched noise coming from inside a flat-panel monitor.	Brightness and contrast settings are too high.	Lower brightness and contrast settings.

Table 4-4 External display problems (continued)

Problem	Cause	Solution
Fuzzy focus; streaking, ghosting, or shadowing effects; horizontal scrolling lines; faint vertical bars; unable to center the picture on the screen (flat-panel monitors using an analog VGA input connection only.)	Flat-panel monitor's internal digital conversion circuits might be unable to correctly interpret the output synchronization of the graphics card.	1. Select the monitor's **Auto-Adjustment** option in the monitor's onscreen display menu. 2. Manually synchronize the Clock and Clock Phase onscreen display functions.
Some typed symbols do not appear correctly.	The font you are using does not support that symbol.	Use the Character Map to locate and select the appropriate symbol. Select **Start > All Programs > Accessories > System Tools > Character Map**. You can copy the symbol from the Character Map into a document.
	The graphics driver does is not working properly or does not support the symbol set with that resolution.	Try either solution: • Change the panel resolution in the Windows **Control Panel > Screen Resolution** menu or through the control panel for the graphics controller (Intel or nVidia). • Install the latest graphics driver: 1. Boot into the OS and uninstall the graphics driver. 2. Restart the computer. 3. Install the latest graphics driver for your graphics controller.

Solving audio problems

Table 4-5 Audio problems

Problem	Cause	Solution
Sound does not come out of the speaker or headphones.	Software volume control is turned down.	Click the **Speaker** icon on the taskbar and use the volume slider to adjust the volume, and/or adjust the volume control in the audio player.
	The external speakers are not turned on.	Turn on the external speakers.
	External speakers plugged into the wrong audio jack.	See your sound card documentation for proper speaker connection.
	Digital CD audio is not enabled.	Enable digital CD audio: 1. From the Control Panel, select **Device Manager.** 2. Right-click the **DVD/CD-ROM** device and select **Properties**. 3. On the **Driver Properties** tab, select **Enable**.
	Headphones or devices connected to the line-out connector have muted the internal speaker.	Turn on and use headphones or external speakers, if connected, or disconnect headphones or external speakers.
	Volume is muted.	Click the **Speaker** icon on the taskbar and make sure the mute button below the volume slider is not selected.
	Computer is in Standby mode.	Press the power button to resume from Standby mode.
Sound quality (such as tone, focus, space, equalization, treble or bass) from the internal speakers is not acceptable.	The graphic equalizer (EQ) and/or SRS audio enhancement settings have been changed and are not appropriate for the audio content being played.	1. Open the SRS user interface (found either in the Control Panel or the taskbar). 2. Go to the Advanced Settings tab. 3. Click the Reset button under Default Settings. This restores the SRS audio enhancement settings, graphic equalizer, and volume to the default settings, which are optimized for most audio content.
Sound occurs intermittently.	Processor resources are being used by other open applications.	Shut down all open processor-intensive applications.
Workstation appears to be locked up while recording audio.	The hard disk might be full.	1. Before recording, be sure there is enough free space on the hard disk. 2. Try recording the audio file in a compressed format.
The optical S/PDIF output does not work.	S/PDIF is not the default audio output device.	1. Go to **Control Panel > Sound**. 2. On the **Playback** tab, select **Digital Output (S/PDIF)**. 3. Click **Set Default**.

Table 4-5 Audio problems (continued)

Problem	Cause	Solution
Audio over DisplayPort is not working.	Either the monitor does not support audio, or DisplayPort is not the default audio output.	1. Go to **Control Panel > Sound**. 2. On the **Playback** tab, select the DisplayPort monitor. (If there is no monitor audio device listed, the monitor does not support audio). 3. Click **Set Default**.
Audio input does not work.	The wrong device is set as the default audio input.	1. Go to **Control Panel > Sound**. 2. On the **Recording** tab, select the appropriate input. 3. Click **Set Default**.

Solving printer problems

Table 4-6 Printer problems

Problem	Cause	Solution
Printer does not print.	Printer is not turned on and online.	Turn the printer on and be sure it is online.
	The correct printer driver for the application is not installed.	1. Install the correct printer driver for the application. 2. Try printing using the MS-DOS command: **DIR C:\> [printer port]** Replace *printer port* with the address of the printer used. If the printer works, reload the printer driver.
	If you are on a network, you might not have made a connection to the printer.	Make the proper network connection to the printer.
	Printer might have failed.	Run printer self-test.
Printer does not turn on.	The cables might not be connected properly.	

Self-troubleshooting with HP Vision Diagnostics

Hewlett-Packard Vision Diagnostics is a diagnostic tool that can be used by the end user or technical support personnel to view information about the hardware configuration of the computer and perform hardware troubleshooting on HP desktop and workstation systems. This diagnostic tool is used to troubleshoot hardware failures. Accessible by either CD or USB key, these diagnostics run outside the operating system and make it easy to isolate potential issues that may be related to the operating system and not to the hardware.

HP Vision Diagnostics benefits:

- Captures complete system configuration information that can be shared as an HTML file, including:
  - System serial number, product number and BIOS revision
  - Memory size and configuration
  - Processor information
  - Storage device information and configuration
  - Graphics, audio, and communications information and configuration
- Comprehensive list of diagnostic tests:
  - Highly configurable testing options: quick, complete, custom, interactive, non-interactive
  - Identifies specific failed memory DIMM
  - Tests video card memory
  - Launches DST Smart tests for both SATA and SAS drives
  - Many other tests and diagnostics
- Diagnostic Failure Code Output — A unique warranty code is generated for each failure and can be used to validate diagnostic use for a specific system.
- Easy to use — Interface is similar to previous field diagnostics, HP Insight Diagnostics
- True End2End diagnostics — Same diagnostics modules used in factory
- Easy to obtain:
  - Download from web
  - Install on bootable USB key, CD or DVD
  - Included with restore media

Overview

HP Vision Diagnostics allows you to view information about the hardware configuration of the computer and perform hardware diagnostic tests on the subsystems of the computer. The utility simplifies the process of effectively identifying, diagnosing, and isolating hardware issues.

When started, HP Vision Diagnostics displays the **Survey** tab, which shows the current configuration of the computer. Other tabs provide additional information, including diagnostic test options and test

results. The information in each tabcan be saved as an HTML file and stored on an optical disc or USB flash drive.

Use HP Vision Diagnostics to determine if all the devices installed on the computer are recognized by the system and functioning properly. Running tests is optional but recommended after installing or connecting a new device.

Before placing a call to the Customer Support Center HP recommends you run the tests, then save and print the test results so that you have the reports available.

NOTE: Third-party devices may not be detected by HP Vision Diagnostics.

Downloading and accessing HP Vision Diagnostics

Follow these steps to download the HP Vision Diagnostics utility from the HP website to a DVD or USB, and then use it to perform diagnostics on the computer:

1. Go to http://www.hp.com.
2. Click the **Support and Drivers** link.
3. Click the **Drivers and Software** link.
4. Enter your product number in the text box, and then press **Search**.
5. Select your operating system.
6. Under the operating system section, select **Diagnostic**.
7. Locate **HP Vision Diagnostics**. Click **Download** next to the most recent version appropriate tfor your target media (USB flash or ISO file for CD).
8. Copy the file to an optical disc or follow the instructions to install the diagnostics on a USB flash drive.
9. While the computer is on, insert the disc or flash drive.
10. Shut down the operating system and turn off the computer.
11. Turn on the computer. The system will boot into HP Vision Diagnostics.

NOTE: If the system does not boot to the disc in the optical drive or to the USB flash drive, you might need to change the boot order. Use the Computer Setup (F10) utility to change the boot order, or press F9 to select the appropriate boot device.

12. At the boot menu, select either the **HP Vision Diagnostics** utility to test the various hardware components in the computer or the **HP Memory Test** utility to test memory only.
13. If running HP Vision Diagnostics, select the appropriate language and click **Continue**.
14. In the End User License Agreement page, select **Agree** if you agree with the terms. The HP Vision Diagnostics utility launches with the Survey tab displayed.

Accessing HP Vision Diagnostics on the computer

The following procedures describe how to access the HP Vision Diagnostics utilities that are included in the computer software.

Creating and using a bootable USB key

This section describes how to use a USB key to access the HP Vision Diagnostics.

NOTE: Using a USB key is the most convenient method to access the HP Vision Diagnostics. It is faster than using a CD, and it accommodates both Memory and Vision diagnostics.

The HP Memory Test is a comprehensive memory diagnostic utility that is run as a stand-alone application, outside of HP Vision Diagnostics. If the computer is booted from a CD, a separate boot CD will be required to use the memory diagnostic.

1. In the C:\VisionDiagnostics\ directory, double-click on VisionDiagUSB.exe. A setup menu appears.
2. Follow the setup prompts to create a bootable ISO image of the diagnostic utilities on a USB key.
3. Turn off the computer and restart it with the USB key installed. The computer will boot to the USB key and initiate the HP Vision Diagnostics utility.
4. Follow the HP Vision Diagnostic prompts to troubleshoot the computer.

Creating and using a bootable DVD

This section describes how to use a DVD to access the HP Vision Diagnostics.

1. In the C:\VisionDiagnostics\ directory, double-click on the VisionDiagISO.exe file. A setup menu appears.
2. Follow the setup prompts to create a bootable ISO image of the diagnostic utilities on a DVD.
3. Enable the computer to boot from DVD.
4. Turn off the computer and restart it with the DVD installed in the optical drive. The computer will boot to the DVD and initiate the HP Vision Diagnostics utility.
5. Follow the HP Vision Diagnostic prompts to troubleshoot the computer.

Using the HP Memory Test utility

This section describes how to access the HP Memory Test utility.

NOTE: The HP Memory Test is a comprehensive memory diagnostic utility that is run as a stand-alone application, outside of HP Vision Diagnostics.

If the computer is booted from a CD, a separate boot CD will be required to use the memory diagnostic. Hence, HP recommends that a USB key be used to boot the diagnostic utilities. It is faster than using a CD, and it accommodates both Memory and Vision diagnostics.

1. In the C:\VisionDiagnostics\ directory, double-click on the MemoryDiagISO.exe file. A setup menu appears.
2. Follow the setup prompts to create a bootable ISO image of the memory diagnostic utility on a DVD.
3. Turn off the computer and restart it with the DVD installed in the optical drive. The computer will boot to the DVD and initiate the memory diagnostic utility.
4. Follow the diagnostic prompts to troubleshoot computer memory.

User interface

The HP Vision Diagnostics application provides six major functions, accessible through tabs:

- **Survey** — Current system hardware information
- **Test** — List of all diagnostics available for the system; tests are started here
- **Status** — Progress and status of currently running diagnostics
- **History** — Past diagnostics runs and status
- **Errors** — Past diagnostics failures
- **Help** — User help about HP Vision Diagnostics

Common operations include:

- **Exit Diagnostics** button — Closes HP Vision Diagnostic application and reboots the system; any running test is aborted.
- **Reload** button — If available, rescans your system hardware and reloads the diagnostics without the need to restart the system.
- **Save** button — If available, saves your system survey, test history or error data as an HTML file to removable media.

Survey tab

The Survey tab shows your system hardware information, organized into eleven Categories (for example *Processors*) and device instances (for example *Processor 1*).

You can control the amount of information displayed by selecting a combination of **View Level** and **Category**.

The **View Levels** include:

- **Overview** (default) — High-level summary of the system hardware
- **Summary** — Limited configuration data for each specific category
- **Advanced** — More technical and low-level data for the computer-savvy user

The **Categories Levels** include:

- **All** — All categories
- **Architecture** — System architecture information such as high-level PCI devices, low-level SMBIOS, CMOS, and PCI configuration space data
- **Audio** — All embedded and add-on audio devices
- **Asset Control** — Asset control related information such as product name, serial number, asset tag, and universal unique ID information
- **Communication** — Communication devices such as serial, parallel, USB, network, IEEE-1394a, modem, and Bluetooth ports and devices
- **Graphics** — All embedded and add-on video cards
- **Input Devices** — User input devices such as all connected mice and keyboards
- **Memory** — System memory information
- **Miscellaneous** — Any device or data that doesn't belong to any other category
- **Processors** — System processors
- **Storage** — Mass storage devices such as floppy drives, optical drives, SATA, SAS hard disk drives and controllers, as well as any RAID arrays
- **System** — Information about system board devices such as fans and cables

Test tab

The Test tab lists all available diagnostics. The lists have been tailored according to your system configuration. Individual test may be selected or unselected.

Tests have three modes:

- **Quick** — Test runs quickly while covering all hardware. Test parameters cannot be modified.
- **Complete** — Includes all available tests and may take a long time to complete. Test parameters cannot be modified.
- **Custom** — Includes all available tests and may take a long time to complete. Test parameters may be modified to fit specific needs. For advanced users only!

By default, the three test modes do not display prompts and require no interaction. Any errors are displayed when testing is complete.

However, for each test type, you may also optionally add interactive tests by clicking the **Include interactive tests** box under Test mode. Selecting interactive tests provides the maximum control over the testing process. The diagnostic software will prompt you for input during tests.

NOTE: Memory can not be tested from within the HP Vision Diagnostics application. To test the memory in your computer, exit HP Vision Diagnostic, boot to either the CD or USB flash drive and select **HP Memory Test** from the boot menu.

The **Duration of Test** options control the duration of the test sequence:

- **Number of loops** — Test runs specified number of times (default is 1).
- **Total test time (hours:minutes)** — Test runs for a specified amount of time; some tests might not run if the specified time is not long enough to run all tests.
- **Stop at first error** — Test stops as soon as one error is encountered.

Test Controls provide additional functions:

- **Select All, Unselect All** — Select/unselect all tests in test selection tree
- **Expand, Collapse** — Expand/collapse test selection tree
- **Start Test** — Starts executing selected tests and switches to the Status tab to display test execution and status

WARNING! Once started, do not reboot or power off your computer until all the tests have been completed.

To begin testing:

1. Select the **Test** tab.
2. Select the type of tests you want to run: **Quick**, **Complete**, or **Custom**.
3. Include optional interactive tests by selecting **Include interactive tests**.
4. Choose how you want the test to be executed, either **Number of Loops** or **Total Test Time**. When choosing to run the test over a specified number of loops, enter the number of loops to perform. If you want the diagnostic test for a specified time period, enter the amount of time in minutes.

5. Click the **Start Test** button. The **Status** tab, which allows you to monitor the progress of the tests, automatically displays during the testing process. When the tests are complete, the Status tab shows whether the devices passed or failed.
6. If errors are found, go to the **Errors** tab to view detailed information and recommended actions.

Status tab

The color-coded Status tab displays the overall progress and status of the test scenario and of each test.

The states and colors are:

- **Waiting** (black) — No test is running.
- **Running** (blue) — At least one test is currently running.
- **Passed** (green) — All tests have run successfully, meaning that no hardware error or defect was detected.
- **Failed** (red) — The tests have detected at least one error with your system.
- **Canceled** (orange) — The test scenario has been explicitly canceled, in which case no pass or fail conclusion can be drawn.

The available data is:

- **Current Loop** — Current execution loop out of total number of loops specified in the Test panel
- **Test Time** — Total time elapsed since the beginning of the test execution
- **Test Complete** — Number of tests successfully completed out of the total number of test to execute
- **Cancel** button — Immediately terminates all currently running tests

History tab

The History tab shows the history of the past test executions.

The History Log displays all tests that have been executed, the number of times of execution, the number of times failed, the date each test was executed, and the time it took to complete each test. The **Clear History** button will clear the contents of the History Log.

The contents of the History Log may be saved as a HTML file to either floppy or USB flash drive by clicking the **Save** button.

Errors tab

The Errors tab displays detailed information about any errors found, as well as any recommended actions.

The Error Log displays the tests for devices that have failed during the diagnostic testing and includes the following information:

- Device — Device tested
- Test — Type of test run
- Times Failed — Number of times the device has failed a test
- Defect Code — Numerical code for the failure (error codes are defined in the Help tab)
- Description — Error the diagnostic test found
- Reason — Likely cause of the error
- Recommended Repair — Recommended action that should be performed to resolve the failed hardware
- Warranty ID — A unique error code associated with the specific error on your computer; be prepared to provide it when contacting the HP Support Center for assistance with a hardware failure.
- Clear Errors — Clears the contents of the Error Log

Click the **Save** button to save the Error Log as an HTML file to removable media.

Help tab

The Help tab contains a Vision Help section and a Test Components section. This tab includes search and index features. You may also review the HP End User License Agreement (EULA), as well as the HP Vision Diagnostic application version information on this tab.

The Help sections are:

- Vision Help — Help on the major functions of HP Vision Diagnostics
- Test components — A description of each test, as well as the parameters that may be adjusted when running in Custom test mode
- Defect codes — Descriptions of the numerical error codes that appear in the Errors tab
- Memory test tab — Information on the HP Memory Test application that can be launched from the boot menu
- HP Support — How to obtain support from HP

Saving and printing information in HP Vision Diagnostics

You can save the information displayed in the HP Vision Diagnostics Survey, History and Errors tabs to removable media. You cannot save to the hard drive. The system automatically creates an HTML file that has the same appearance as the information displayed on the screen.

1. Insert removable media.
2. Click **Save** in the bottom on any of the Survey, History or Errors tabs. The three log files are saved regardless of where the Save button is clicked.
3. Select the removable media drive and click **Save**.

NOTE: Do not remove the media until a message indicates the files have been written.

4. Print the desired information HTML file.

NOTE: To exit HP Vision Diagnostics, click **Exit Diagnostics** at the bottom of the screen. Be sure to remove the removable media.

Diagnostic codes and errors

This section presents information about diagnostic LED codes, LED color definitions, and POST error messages to help you troubleshoot problems.

Diagnostic LED and audible (beep) codes

This section describes the front panel LED error and operation codes as well as the audible codes that might occur before or during the POST.

Table 4-7 Diagnostic lights and audible codes

Activity	Possible cause	Recommended action
Blue Power LED on. No beeps.	Computer on.	N/A
Blue Power LED blinks every two seconds. No beeps.	Computer in Sleep mode (S3-Suspend to RAM). Select models only.	
Blue Power LED is off. No beeps.	Computer in Hibernate mode (S4-Suspend to disk) or system is off (S5).	
Blue Power LED blinks three times*, once per second. No beeps.	Computer in Sleep mode (S3-Suspend to RAM). Select models only.	
Blue Power LED blinks four times*, once per second. No beeps.	Computer in Hibernate mode (S4-Suspend to disk).	
*User-selectable. See Computer Setup (F10) Utility menu on page 15 for details.		
For the following LED activity and beeps, the beeps are heard through the chassis speaker. Blinks and beeps repeat for five cycles, after which, only the blinks continue to repeat.		
Red Power LED blinks two times, once every second, followed by a two-second pause. Two beeps.	CPU thermal protection activated by either of the following methods: • A fan might be blocked or not turning. • The heatsink and fan assembly is not properly attached to the CPU.	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. 1. Ensure that the computer air vents are not blocked and the cooling fan is running. 2. Open the access panel, press power button, and verify that the CPU fan is spinning. If the CPU fan is not spinning, make sure the fan cable is plugged into the computer board header. Ensure the fan is fully and properly seated or installed. 3. If fan is plugged in and seated properly, but is not spinning, the problem might be in the CPU fan. Contact HP for assistance. 4. Verify that the fan assembly is properly attached. If problems persist, there might be a problem with the CPU heatsink. Contact HP for assistance.

Table 4-7 Diagnostic lights and audible codes (continued)

Activity	Possible cause	Recommended action
Red Power LED blinks three times, once every second, followed by a two-second pause. Three beeps.	CPU not installed (not an indicator of bad CPU).	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. 1. Verify that the CPU is present. 2. Reseat the CPU.
Red Power LED blinks four times, once every second, followed by a two-second pause. Four beeps.	Power failure (power supply is overloaded).	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. 1. Open the access panel and ensure that all power connections are secure on the system board. 2. Check if a device is causing the problem by removing **all** attached devices (such as hard disks optical disk drives, and expansion cards.) Power on the computer. If the system enters the POST, power off and replace one device at a time; repeat this procedure until failure occurs. Replace the device that is causing the failure. Continue adding devices one at a time to ensure all devices are functioning properly.
Red Power LED blinks five times, once every second, followed by a two-second pause. Five beeps.	Pre-video memory error.	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. 1. Reseat DIMMs. 2. Replace DIMMs one at a time to isolate faulty module. 3. Replace third-party memory with HP memory. 4. The problem might be on the system board. Contact HP for assistance.
Red Power LED blinks six times, once every second, followed by a two-second pause. Six beeps.	Pre-video graphics error.	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. Try these solutions in this order: • Reseat the graphics card if using nVidia graphics; reseat the processor if using Intel HD Graphics. • Replace the graphics card if using nVidia graphics or replace the processor if using Intel HD graphics. • Replace the system board.
	Processor does not support graphics output and no discrete graphics card is installed.	Either install a processor with Intel HD Graphics, or install a supported graphics card.
Red Power LED blinks seven times, once every second, followed by a two- second pause. Seven beeps.	System board failure (ROM detected failure prior to video).	1. Clear CMOS. **NOTE:** See Clearing and resetting the CMOS on page 95 for details. 2. The problem might be on the system board. Contact HP for assistance.

Table 4-7 Diagnostic lights and audible codes (continued)

Activity	Possible cause	Recommended action
Red Power LED blinks eight times, once every second, followed by a two-second pause. Eight beeps.	Invalid ROM based on bad checksum.	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. 1. Clear CMOS. **NOTE:** See Clearing and resetting the CMOS on page 95 for details. 2. Upgrade the ROM using SoftPaq, either from the hard disk drive, CD, diskette, or USB removable device (for example, HP Drive Key). See the ROM Flash section of the *Maintenance and Service Guide* at http://www.hp.com/support/workstation_manuals. SoftPaq is a self-extracting executable, which contains instructions for its use, that enables you to upgrade the ROM. To download the Softpaq executable, visit http://www.hp.com/go/workstationsupport. 3. The problem might be on the system board. Contact HP for assistance.
Red Power LED blinks nine times, once every second, followed by a two-second pause. Nine beeps.	System powers on but does not start.	1. The problem might be on the system board. Contact HP for assistance. 2. The problem might be in the CPU. Contact HP for assistance.
System does not power-on and LEDs are not blinking. No beeps.	System unable to power on.	**CAUTION:** Internal components might be powered even when the computer is off. To prevent damage, disconnect the computer power cord before you remove a component. To resolve the problem, choose one of the following options: Press and hold the power button for less than four seconds. If the hard disk drive LED turns green, then: 1. Remove the expansion cards one at a time and try holding the power button again for less than four seconds. 2. The problem might be on the system board. Contact HP for assistance. Press and hold the power button for less than four seconds. If the hard disk drive LED does not turn on green then: 1. Check that unit is plugged into a working AC outlet. 2. Open the access panel and check that the power button harness is properly connected to the system board. 3. Check that **all** power supply cables are properly connected to the system board.

* The BIOS option you select controls the blue LED function during these suspend modes.

LED color definitions

The following table describes what each LED light on the computer front panel signifies.

Table 4-8 LED color definitions

LED state	LED color	System status
Solid	Blue	System is on.
Flashing	Blue	System is in Standby.
Solid or flashing	Red	System has experienced an error. (See POST error messages on page 87.)
None	No light	System is in Hibernate, or is off.

POST error messages

The Power-On Self Text (POST) is a series of diagnostic tests that runs automatically when the computer is powered on.

Audible and visual messages occur before the operating system starts if the POST encounters a problem. POST checks the following items to ensure that the computer system is functioning properly:

- Keyboard
- DIMMs
- CD or DVD drives
- All mass storage devices
- CPUs
- Controllers
- Fans
- Temperature sensors
- Cables (front/rear panels, audio, and USB ports)

The table shown next describes the POST error messages.

Table 4-9 POST error messages

Screen message	Probable cause	Recommended action
101—Option ROM Checksum Error	System ROM checksum.	Verify the you have the latest ROM: 1. Flash the ROM, if needed. 2. If an expansion card was recently added, remove it to find out if the problem remains. 3. Clear CMOS. If the message disappears, there might be a problem with the expansion card. 4. Replace the system board.
102—System Board Failure	DMA, timers, and so forth, might be set improperly or might be defective.	1. Clear the CMOS. 2. Remove the expansion boards. 3. Replace the system board.
110—Out of memory space for option ROMs	Option ROM for a device could not run because of memory constraints.	Run the Computer Setup (F10) Utility to disable unneeded option ROMs, and to enable ACP1/ USB Buffers at Top of Memory.
162—Systems Options Error		

Table 4-9 POST error messages (continued)

Screen message	Probable cause	Recommended action
163—Time and Date Not Set	• Invalid time or date in configuration memory. • RTC battery might need replacement. • CMOS jumper might not be properly installed.	1. Set the date and time from the Control Panel or in the Computer Setup (F10) Utility (depending on the operating system). 2. If the problem persists, replace the RTC battery.
164—Memory Size changed	Memory configuration is incorrect.	1. Run the Computer Setup (F10) Utility or the Windows utilities. 2. Verify that the memory modules are installed properly. 3. If third-party memory has been added, test the memory configuration using HP memory. 4. Verify the memory module type.
201—Memory Error	RAM failure.	1. Run the Computer Setup (F10) utility or the Windows utilities. 2. Be sure that memory modules are installed correctly. 3. Verify the memory module type. 4. Remove and replace memory modules one at a time to isolate faulty modules. 5. Replace faulty memory modules. 6. If the error persists after replacing memory modules, replace the system board.
202—Memory Type Mismatch	Memory modules do not match.	Replace the memory modules with matched sets.
203—Memory module failed self-test and failing rank was disabled	Defective memory module.	Replace the memory module.
204—Memory module failed and user rank was disabled	Improper module load.	Reseat the memory module correctly.
205—Memory high temperature detected	Insufficient memory module cooling.	Verify that a memory module cooling fan is installed and operating.
206—Memory setup invalid	Memory configured incorrectly.	Reconfigure the memory modules in the proper slots.
207—Incompatible DIMMs detected	DIMMs are installed that do not fulfill system requirements.	1. Verify that the memory module type matches computer requirements. 2. Insert the DIMM in the proper memory socket. 3. Replace the DIMM if the problem persists.

Table 4-9 POST error messages (continued)

Screen message	Probable cause	Recommended action
208—Mismatched DIMMs detected	Installed DIMMs are improperly matched.	Verify that matching DIMMs are installed.
209—Memory warning condition detected	Incorrect memory module type in use.	Verify that the memory modules are compatible with computer requirements.
212—Failed Processor 0	Processor has failed to initialize.	1. Reseat the processor in its socket. 2. If the processor does not respond, replace it. 3. Replace the system board.
213—Incompatible Memory Modules	A memory module in the memory socket identified in the error message is missing critical SPD information, or is incompatible with the chipset.	1. Verify the memory module type. 2. Insert the DIMM in another memory socket. 3. Replace the module with a DIMM conforming to the SPD standard.
214—DIMM Configuration Warning	DIMMs are not installed correctly (not paired correctly).	See the service label on the computer access panel for the correct memory configurations, and reseat the DIMMs accordingly.
215—DIMM Configuration Error		
216—Memory Size Exceeds Maximum Supported	The amount of memory installed exceeds that supported by the hardware.	1. Verify how much memory the computer supports. 2. Remove the excess memory.
301—Keyboard Error	Keyboard failure.	1. Reconnect the keyboard with the computer powered off. 2. Check the connector for bent or missing pins. 3. Be sure that none of the keys are pressed. 4. Replace the keyboard.
303—Keyboard Controller Error	I/O board keyboard controller is defective or is not set properly.	1. Reconnect the keyboard with the computer powered off. 2. Connect a keyboard directly to the computer (instead of through a switch box). 3. Replace the system board.
304—Keyboard or System Unit Error	Keyboard failure.	1. Reconnect the keyboard with the computer powered off. 2. Connect a keyboard directly to the computer (instead of through a switch box). 3. Be sure that none of the keys are pressed. 4. Replace keyboard. 5. Replace system board.

Table 4-9 POST error messages (continued)

Screen message	Probable cause	Recommended action
510—Splash Screen image corrupted	Splash Screen image has errors.	Update system UEFI.
511—CPU Fan not detected	Fan is not connected or is defective.	1. Reseat the fan cable. 2. Reseat the fan. 3. Replace the fan.
515—CPU Overtemp occurred	Insufficient processor cooling or processor defect.	1. If necessary, add a heatsink to the processor and ensure proper operation. 2. Replace the processor.
516—MXM fan not detected	MXM fan missing, disconnected, or defective.	1. Reseat the fan cable. 2. Reseat the fan. 3. Replace the fan.
517—Memory fan not detected	Memory fan missing, disconnected, or defective.	1. Reseat the fan cable. 2. Reseat the fan. 3. Replace the fan.
530—Left DMIC cable not connected.	Left Dmic cable is not connected to the system board or to the left Dmic.	1. Reseat the cable. 2. Replace the cable.
531—Right DMIC cable not connected.	Right Dmic cable is not connected to the system board or to the right Dmic.	1. Reseat the cable. 2. Replace the cable.
532—Side I/O board not connected.	Side I/O board is missing or is not connected.	1. Reseat the Side I/O board. 2. Replace the Side I/O board. 3. Replace the system board.
533—Rear I/O USB/Audio cable not connected.	The Rear I/O USB/Audio cable between the system board and Rear I/O board is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
534—Rear I/O DP/LAN cable not connected.	The Rear I/O DP/LAN cable between the system board and Rear I/O board is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
535—LED Backlight cable not connected.	The LED Sync/backlight cable between the system board and the LCD panel is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
536—LCD DP cable not connected.	The LCD DP cable between the system board and the LCD panel is missing or not connected.	1. Reseat the cable. 2. Replace the cable.

Table 4-9 POST error messages (continued)

Screen message	Probable cause	Recommended action
537—Bluetooth® module not connected.	The Bluetooth module is missing or not connected.	1. Replace or reconnect the missing Bluetooth module. 2. Replace or reseat the missing module cable.
538—Panel I/O cable not connected.	The Panel I/O cable is missing or not connected.	1. Reseat the cable. 2. Replace the cable.
912—Computer Cover Has Been Removed Since Last System Start Up	N/A	No action required.
922—Fatal error on PCIe slot X	Fatal error occurred in the designated slot.	Move the card to a different slot. If the problem persists, replace the card.
925—Fatal Misc error	A fatal miscellaneous chipset error was detected.	Contact HP Support.
928—Fatal machine check detected on CPU X		Contact HP support.
929—Fatal MCA error	An MCA condition was detected on the system.	Contact HP Support.
942—Memory Training error	A DIMM or DIMMs did not train correctly	Contact HP Support.
1720—SMART Hard Drive Detects Imminent Failure	Hard drive is about to fail. (Some hard disk drives have a firmware patch that fixes erroneous error messages.)	1. Determine if the hard disk drive is giving a correct error message. 2. Run the Drive Protection System test (if applicable). 3. Apply firmware patch (if applicable). See http://www.hp.com/support. 4. Back up contents and replace the hard disk drive.
1783—Fixed Disk 0/1 locked	Hard disk drive failure.	Diagnose the hard disk drive, and replace it if necessary.
1796—SATA Cabling Error	Missing or improperly attached cable.	Verify that a cable is attached. Reattach the cable.
1797—SATA Drivelock is not supported in RAID mode	SATA Drivelock is not supported in RAID mode.	Disable RAID mode, or disable SATA drivelock..
1801—Microcode Update Error	Unknown or unsupported processor stepping.	The microcode update failed. Check the processor stepping to ensure it is a supported stepping. If it is contact, HP Support.
1802—Processor Not Supported	The system board does not support the processor.	Replace the processor with a compatible one.
1803—Processor feature set is insufficient for current system settings	Processor feature set is insufficient for current system settings. The UEFI settings do not match the support provided by the processor	Change the UEFI settings or upgrade the processor.

Table 4-9 POST error messages (continued)

Screen message	Probable cause	Recommended action
1804—A processor feature and the memory configuration are incompatible	A processor feature is incompatible with the memory configuration.	Restore the previous memory configuration.
ERROR: Invalid 1394 GUID (Invalid electronic serial number)	No electronic serial number is stored with the system.	To assign a serial number, open Computer Setup (F10) Utility, and then select **Security > System IDs**.
ERROR: Invalid electronic serial number (no number)	No electronic serial number is stored with the system	To assign a serial number, open Computer Select (F10) Utility, and then select **Security > System IDs**.
ERROR: An unsupported processor is installed. System halted	Unsupported processor detected.	Replace the processor.
Invalid electronic serial number	Incorrect serial number registered in the system.	To assign a serial number, open Computer Select (F10) Utility, and then select **Security > System IDs**.
Processor initialization fails	Processor defective.	Replace the processor.

5 Configuring password security and resetting CMOS

This chapter describes how to configure password security and to reset CMOS, and includes these topics:

- Preparing to configure passwords on page 93
- Resetting the password jumper on page 93
- Clearing and resetting the CMOS on page 95

Preparing to configure passwords

The Computer Setup (F10) Utility enables you to create setup and power-on passwords.

There are three possibilities for setting passwords:

- Define a setup password only. You will need the password to enter Computer Setup (F10) Utility, but you will not need a password to start the workstation.
- Define a power-on password only. This password lets you start the workstation or enter the setup utility.
- Define both. In this case, the setup password lets you start the workstation and enter the setup utility. The power-on password starts the workstation but does not let you enter the setup utility,

After you create both passwords, you can use the setup password in place of the power-on password as an override to log into the computer (a useful feature for a network administrator).

NOTE: You can only clear the passwords with the password jumper. Clearing CMOS does not clear the passwords.

CAUTION: Before pressing the Clear CMOS button, back up your computer CMOS settings.

Pressing the Clear CMOS button resets CMOS values to factory defaults and erases customized information, including asset numbers and special settings.

To back up the CMOS settings, run the Computer Setup (F10) Utility and select **Save to Diskette** from the File menu.

Resetting the password jumper

Use the following procedure to disable the power-on or setup password features and clear the power-on and setup passwords.

WARNING! To reduce the risk of personal injury from electrical shock and hot surfaces, be sure to disconnect the power cord from the wall outlet and allow the internal system components to cool before touching.

⚠ **CAUTION:** When the computer is plugged in, the power supply has voltage applied to the system board, even when the computer is turned off. Failure to disconnect the power cord can result in damage to the system.

⚠ **CAUTION:** Static electricity can damage the electronic components of the computer or optional equipment. Before beginning these procedures, be sure that you are discharged of static electricity by briefly touching a grounded metal object.

1. Access the jumper:
   a. Shut down the operating system, turn off the computer and external devices, and then disconnect the power cords from the computer and external devices.
   b. Disconnect any external devices.
   c. Open the workstation.
   d. Locate the password header and jumper.

      The password header is E49. The password jumper is blue so it can be easily identified.
2. Remove the jumper from pins 1 and 2. Do not lose the jumper.
3. Restart the computer:
   a. Close the workstation.
   b. Reconnect the AC power cord to the computer.
   c. Turn on the computer and wait for the workstation to display the HP splash screen.
4. Repeat step 1.
5. Replace the jumper on pins 1 and 2.
6. Repeat step 3, except press the F10 key during startup to access Computer Setup (F10) Utility.
7. Use the setup utility to create new passwords.

Clearing and resetting the CMOS

This section describes the steps necessary to successfully clear and reset the CMOS. The CMOS of the computer stores password information and information about the computer configuration.

Using the CMOS button to reset CMOS

To clear CMOS using the Clear CMOS button, use the following procedure:

WARNING! To reduce the risk of personal injury from electrical shock and hot surfaces, disconnect the power cord from the wall outlet and allow the internal system components to cool before touching.

CAUTION: When the computer is plugged in, the power supply has voltage applied to the system board, even when the computer is turned off. Failure to disconnect the power cord can result in damage to the system.

Static electricity can damage the electronic components of the computer or optional equipment. Before beginning these procedures, be sure that you are discharged of static electricity by briefly touching a grounded metal object.

1. Back up your computer CMOS settings with Computer Setup (F10) Utility, and select **File > Save to Disk**.

   CAUTION: Pressing the Clear CMOS button resets CMOS values to factory defaults and erases customized information, including asset numbers and special settings.

2. Shut down the operating system, turn off the computer and external devices, and disconnect any external devices.
3. Disconnect the AC power cord from the computer and wait 30 seconds for the power to dissipate.

   NOTE: The Clear CMOS button does not clear CMOS if the AC power cord is connected to the computer.

4. Open the workstation.
5. Locate and press the CMOS button.

   For assistance locating the CMOS button and other system board components, see the system board layout in System board components on page 6.

6. Close the workstation, reconnect external devices, connect the power cord to the workstation, and then turn on the workstation.
7. The system boots to an F1 prompt and displays a message that the date/time has changed and that system options have changed.
8. Press F1. The system shuts down for three seconds and then restarts.
9. Use Computer Setup (F10) Utility to reset the date and time.

Using Computer Setup (F10) Utility to reset CMOS

1. Access Computer Setup (F10) Utility menu.
2. When the computer setup message appears in the lower-right corner of the screen, press F10, and then press Enter to bypass the title screen, if necessary.

   If you do not press F10 while the message is displayed, the computer must be rebooted to access this utility.
3. From Computer Setup (F10) Utility menu, select **File > Default Setup**.

   This restores the settings that include boot sequence order and other factory settings. However, it does not force hardware rediscovery.
4. Choose **Restore Factory Settings as Default**, and then press F10 to accept.
5. Select **File > Apply Defaults and Exit**, and then press Enter to accept.
6. Reset the computer passwords and configuration information, such as the system date and time.

NOTE: This step does not clear the passwords.

A Linux technical notes

HP offers a variety of Linux solutions for HP workstation customers:

- HP certifies and supports Red Hat Enterprise Linux (RHEL) on HP workstations.
- HP certifies SUSE Linux Enterprise Desktop (SLED) on HP workstations.
- HP offers a SLED 11 preload on some Z Series workstations.

For Linux setup and restore procedures, see the user guide for your workstation at http://www.hp.com/support/workstation_manuals.

Topics
System RAM on page 97
Audio on page 97
Network cards on page 98
Hyper-Threading Technology on page 98
NVIDIA Graphics Workstations on page 99

NOTE: After you set up the operating system, make sure that the latest BIOS, drivers, and software updates are installed.

CAUTION: Do not add optional hardware or third-party devices to the workstation until the operating system is successfully installed. Adding hardware might cause errors and prevent the operating system from installing correctly.

System RAM

HP supports different amounts of total RAM in various HP workstations, based on the number of hardware DIMM slots and the capabilities of the system. The total memory supported for each configuration is listed in the *Hardware Support Matrix for HP Linux Workstations* at http://www.hp.com/support/linux_hardware_matrix.

Audio

All HP workstations come with built-in audio hardware. The audio hardware is supported by the *Advanced Linux Sound Architecture* (ALSA) drivers included with all modern Linux distributions.

The audio hardware provides basic playback and recording features. The ability to simultaneously play audio from multiple sources, such as applications and CDs, is provided by software mixing functionality in the ALSA driver. The performance of software audio mixing and playback functionality is greatly improved in ALSA version 1.0.13 and later drivers.

After the NVIDIA proprietary driver is installed, the optional NVIDIA graphics devices supported in the HP Z1 Workstation also provide audio functionality over HDMI, which can be passed through the external DisplayPort connector to a monitor with audio capabilities. Such a configuration may present two audio hardware choices. If you do not hear sound through the speakers, one possible reason is that the NVIDIA audio device has been chosen by default. Check the audio settings (for example, **Sound** in GNOME Control Center).

Network cards

All HP workstations include one or two integrated network interface controllers. The HP Z1 Workstation includes a PCI Express Mini Card that implements both wireless LAN and Bluetooth. The `iwlagn` driver supports the wireless LAN; in most distributions, the Network Manager automatically senses that wireless networks are available. Bluetooth support is also available in many Linux distributions.

Hyper-Threading Technology

The Z Series workstations support Hyper-Threading Technology (HTT), an Intel-proprietary technology that improves processor performance through parallelization of computations (doing multiple tasks at once). The operating system treats an HTT-enabled processor as two virtual processors and shares the workload between them when possible. This feature requires that the operating system support multiple processors and be specifically optimized for HTT.

To enable HTT:

1. During startup, press F10 to enter Computer Setup (F10) Utility. Use the arrow keys to navigate and select options.
2. Select **Advanced > Device Options**.
3. Set **Hyper-Threading** to **Enable**, and then press F10 to exit the menu.
4. Select **File > Save Changes and Exit**.
5. Restart the system to enable HTT.

NOTE: On most recent Linux distributions (including RHEL 5, RHEL 6, SLED 11, and updates to those streams), the kernel automatically detects that HTT is enabled and works correctly.

NVIDIA Graphics Workstations

Some HP Z1 workstation configurations come with NVIDIA Quadro graphics hardware. HP recommends the use of NVIDIA proprietary graphics drivers for best results on Linux systems. Driver versions of 295.20 or higher are qualified for HP Z1 workstation applications.

HP also provides recommended versions of the drivers with RPM-compatible installers for RHEL and SLED distributions. These are available from the HP Installer Kit for Linux and from workstation driver repositories on hp.com. When HP installers are used, their contents and documentation links are installed in the `/opt/hp/nvidia` folder.

When installing Linux on an HP Z1 workstation that contains an NVIDIA card, administrators should select a VESA-compatible driver to avoid the instability that is experienced with some open-source versions of the Nouveau and DRM drivers.

Open source versions of Nouveau drivers and NVIDIA proprietary graphics drivers cannot coexist in the same runtime environment because they use the same hardware resources. If administrators create their own Linux environments using NVIDIA proprietary graphics drivers but choose not to use HP-packaged versions, HP recommends that they manually append the following boot loader parameters to properly suppress the Nouveau driver at runtime (grub example below):

```
kernel /vmlinuz ... rdblacklist=nouveau nouveau.modeset=0
```

This action is applied by HP installers but must be applied/restored under other circumstances.

To customize the display characteristics and resolutions of an NVIDIA proprietary graphics driver environment, execute the following command:

```
/usr/bin/nvidia-settings
```

To create and manipulate the /etc/X11/xorg.conf file, execute the following command:

```
/usr/bin/nvidia-xconfig
```

B Configuring RAID devices

This appendix contains the following information:

- Instructions on setting up and managing SATA RAID volumes in Windows
- A summary of software RAID considerations in Linux and references to procedures on configuring software RAID for Linux

The following SATA RAID configurations are supported on workstations that have two 2.5-in hard drives.

- RAID 0 — Striped disk array
  - Two-drive minimum
  - Improved I/O performance
  - No fault tolerance
- RAID 1 — Mirrored disk array
  - Two drives
  - 100% redundancy
  - Can recover from a single-drive failure
  - Provides improved read performance

The following additional information is available:

- For RAID configuration information, go to http://www.hp.com/support/RAID_FAQs.
- For guidelines on preparing for RAID configuration, go to http://www.hp.com/support/workstation_manuals.

Configuring SATA RAID in Windows

This section explains how to use the Intel Rapid Storage Technology utility to set up and manage SATA RAID volumes in Windows.

Configuring the system BIOS to enable embedded SATA RAID functionality

To set up a RAID configuration, the SATA emulation mode must be set to AHCI+RAID in the BIOS setup menu. This is the default setting. If the mode has been changed, follow these steps to change it back.

1. During startup, press F10 to enter Computer Setup (F10) Utility. Use the arrow keys to navigate and select options.
2. Select a language from the list, and then press Enter.
3. Select **Storage > Storage Options**, and then press Enter.
4. Select **SATA Emulation > RAID+AHCI**, and then press F10 to save the settings.

NOTE: The SATA AHCI BIOS executes when you select RAID+AHCI for the SATA emulation mode. This BIOS is used only to support serial-attached drives that are configured as a RAID array.

5. Select **Advanced > Power-On Options**, and then press Enter.
6. Select **POST Messages > Enable**, and then press F10 to save the settings.
7. Select **Advanced > Device Options**, and then press Enter.
8. Select **SATA RAID Option ROM Download**, and then press Enter.
9. Select **Enable**, and then press F10 to save the settings.
10. Select **File > Save Changes and Exit**, and then press Enter.
11. Press Enter to accept the changes when prompted.

Creating RAID volumes

Follow these steps to create RAID volumes.

1. Press Ctrl+I when prompted to enter the Intel Rapid Storage Technology utility. Use the arrow keys to navigate and select options.

   NOTE: If only a single hard drive is attached, the utility does not execute. No message is displayed.

2. Select **1. Create RAID Volume**, then press Enter.
3. Enter the desired RAID volume name in the **Name** field, and then press Tab.
4. Select a level in the **RAID Level** field, and then press Tab.
5. If appropriate, select a size in the **Stripe Size** field, and then press Tab.
6. Enter the desired volume size in the **Capacity** field, and then press Tab.
7. Press Enter to initiate volume creation.
8. When prompted, press Y to acknowledge the warning message and create the volume.
9. Select **5. Exit**, and then press Enter.
10. Press Y when prompted to confirm the exit.

Software RAID solution

This section provides a summary of software RAID considerations when running the Linux operating system, as well as references to configuration procedures.

Software RAID considerations

The Linux kernel software RAID driver (called *md*, for *multiple device*) offers integrated software RAID without the need for additional hardware disk controllers or kernel patches. All that is required are multiple hard disks and a small amount of setup. Unlike most hardware RAID solutions, software RAID can be used with all types of disk technologies, including SATA, SAS, SCSI, and solid-state drives.

Compared to hardware-based RAID, software RAID has disadvantages in managing the disks, breaking up data as necessary, and managing parity data. The CPU must assume some extra loading: disk-intensive workloads result in roughly double the CPU overhead (for example, from 15% to 30%). For most applications, this overhead is easily handled by excess headroom in the processors. But for some applications where disk and CPU performance are very well balanced and already near bottleneck levels, this additional CPU overhead can become troublesome. Hardware RAID offers advantages because of its large hardware cache and the capability for better scheduling of operations in parallel. However, software RAID offers more flexibility for disk and disk controller setup. Additionally, hardware RAID requires that a failed RAID controller must be replaced with an identical model to avoid data loss, whereas software RAID imposes no such requirements.

Some software RAID schemes offer data protection through mirroring (copying the data to multiple disks in case one fails) or parity data (checksums that allow error detection and limited rebuilding of data in case of a failure). For all software RAID solutions on HP workstations, redundancy can be restored only after the system is shut down so that the failed drive can be replaced. In software RAID, this replacement requires only a minimum amount of work.

Performance considerations

Disk I/O bandwidth is typically limited by the system bus speeds, the disk controller, and the disks themselves. The balance of these hardware limitations, as affected by the software configuration, determines the location of the real bottleneck in the system.

Several RAID levels offer improved performance relative to a standalone disk. If the disk throughput is lessened by a single disk controller, there is probably little you can do with RAID to improve the performance without adding another controller. On the other hand, if the raw disk performance is the bottleneck, a tuned software RAID solution can dramatically improve the throughput. The slower the disk is relative to the rest of the system, the better RAID performance will scale, because the slowest piece of the performance pipeline is being directly addressed by moving to RAID.

Configuring software RAID

See the following sites for additional information about configuring software RAID on Red Hat Enterprise Linux (RHEL) or SUSE Linux Enterprise Desktop (SLED):

- **Red Hat Enterprise Linux 6** — See the *Storage Administration Guide* at http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Storage_Administration_Guide/index.html
- **Red Hat Enterprise Linux 5** — See the *Deployment Guide* at http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/5/html/Deployment_Guide/ch-raid.html
- **SLED 11** — See the *Deployment Guide* at http://www.suse.com/documentation/sled11/book_sle_deployment/?page=/documentation/sled11/book_sle_deployment/data/book_sle_deployment.html

See the following site for more information:

For more information about Open Source and Linux at HP, go to http://h10018.www1.hp.com/wwsolutions/linux/index.html.

C System board designators

This appendix describes the system board designators for this computer.

Main system board

Table C-1 Main system board designators

Designator	Name on board	Component
E1	FDO/E1	Flash Descriptor Override header/jumper
E14	BB/E14	Boot Block header/jumper
E15	BBR/E15	Crisis recovery header/jumper
E49	PSWD/E49	Clear password header/jumper
CON4	CON4	Webcam/Digital Mic connector
CON5	CON5	Bluetooth connector (optional)
CON6701	CON6701	Rear DP/LAN connector (white)
J7	J7	Side I/O connector (black)
J15	J15	Rear USB/Audio connector (white)
J16	J16	eDP (embedded DisplayPort) connector (white)
J41	Slot 0 PCIe3 x 16 100W	MXM (PCIe x16) graphics connector (black)
J61	Slot 1 PCIe2 x1 10W	Mini PCIe (PCIe2 x1, USB) connector (black)
J62	Slot 2 PCIe2 x1 10W	Mini PCIe (PCIe2 x1, USB) connector (black)
J63	Slot 3 PCIe2 x1 10W	Mini PCIe (PCIe2 x1, USB) connector (black)
SW50	SW50/CMOS	Clear CMOS button
P1	PWR	Power Supply, 20-pin (white)
P2	PWR LED	LED Sync and Power, 19-pin (black)
P5	PB/LED	Side power button/LED (black)
P9	MXM FAN	MXM blower (white)
P11	MEMFAN	Memory blower (black)
P26	Internal USB	Internal USB 2.0 2x5 header (blue)
P60	SATA0	SATA 6.0 Gbps HDD port (black)
P61	SATA1	SATA 6.0 Gbps HDD port (black)
P62	SATA2	SATA 6.0 Gbps HDD port (black)

Table C-1 Main system board designators (continued)

Designator	Name on board	Component
P70	CPU FAN	CPU cooler (black)
P125	HSENSE	Hood sensor (white)
P163	ODD PWR	SATA ODD power/eject (white)
P9603	P9603/R-SPKR/L-SPKR	Internal speakers (white)
XBT1	XBT1/BAT	Battery holder
XMM1 - XMM4	XMM1 - XMM4	Memory slots
XU1	XU1	CPU socket

Rear I/O board

All connectors (except J90) on the rear I/O board are on the bottom of board.

Table C-2 Rear I/O board designators

Designator	Name on board	Component
J90	J90	Internal USB 2.0 Type A
J8	J8	LAN
J64	J64	DisplayPort
J15	J15	Rear USB/Audio connector (white)
J16	J16	Rear DP/LAN connector (white)
J81	USB	Dual-USB 2.0
J82	USB	Dual-USB 2.0
J5	J5	Optical S/PDIF
J11	J11	Subwoofer jack
J73	IN	Audio Line In jack
J74	J74 OUT	Audio Line out jack

Side I/O board

Table C-3 Side I/O board designators

Designator	Name on board	Component
J72	MIC/J72	Microphone jack
J75	J75/HDPH	Headphone jack
J71	USB J71	USB 3.0
J70	USB J70	USB 3.0
J1	J1	1394a
J2	J2	4-in-1 Card Reader
J7	J7	Side I/O connector (bottom side)